INDEXED.

International Marine Engineering

AUGUST, 1910.

ITALIAN ARMORED CRUISER S. GIORGIO.

BY DAGNINO ATTILIO.

This cruiser is the third of four first-class armored cruisers building for the Italian navy. She was launched from the shipyard of Castello mare di Stabia, near Naples, and engined by Messrs. Ansaldo Armstrong & Company's Engine Works at Sampierdareno. The ship has the following dimensions:

	Feet.
Length over all	461
Length between perpendiculars	427
Extreme beam	69
Depth	39.9
Mean draft	23.6
Maximum draft	24.4
Metacentric height	3.94
Normal displacement in tons	10,118

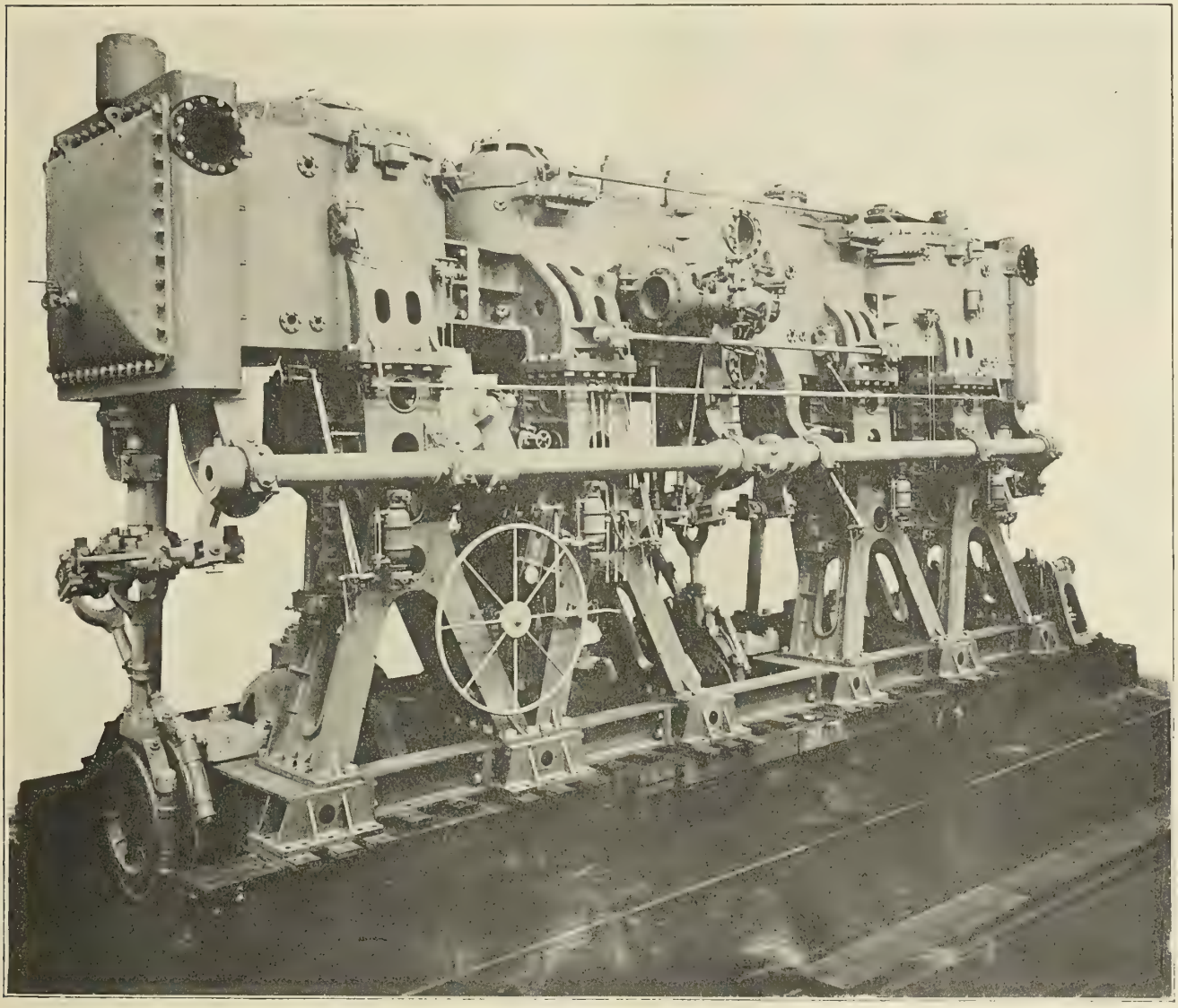


FIG. 1.—STARBOARD ENGINE OF THE ITALIAN ARMORED CRUISER S. GIORGIO. CYLINDER DIAMETERS, 34⅝-56-64⅛-64⅛ INCHES; STROKE, 39⅜ INCHES.

There is a complete armor belt running from stem to stern, with a width of 7 feet 3 inches, of which 4 feet 11 inches is

below the waterline. The maximum thickness is 7.87 inches, decreased to 3.16 inches at stem and stern. The protective deck has a thickness of 1½ inches.

The battery is an extremely powerful one, including four 10-inch guns, 45 calibers long, mounted in pairs in turrets forward and aft, with an arc of fire of 260 degrees. The height of these guns above the water is 24 feet 3 inches. There are eight 7.5-inch guns, 45 calibers long, in pairs in four turrets at the corners of the superstructure. These have an altitude above the water of 22 feet 2 inches. They have a range of fire of 160 degrees. The secondary battery includes sixteen 3-inch guns, eight 3-pounders and four Maxims. There are three 18-inch torpedo tubes, all submerged, two being located just aft the ram, while the other one is just above the rudder. All of the artillery is of the latest Vickers type, and was made in Barrow-in-Furness.

This ship is propelled by twin screws, actuated by triple-expansion engines, with a designed horsepower of 18,000 under forced draft, and at 145 revolutions per minute. In the recent trial trip of six hours a speed of 23 knots was obtained, developing 19,000 indicated horsepower, with a corresponding speed of 20 knots at 15,000 horsepower and natural draft.

The two main engines are four-cylinder triple-expansion of the vertical inverted type, balanced according to the Yarrow, Schlick, Tweedy system. They are placed in two separate compartments, with a central bulkhead between. The boiler pressure is 240 pounds per square inch.

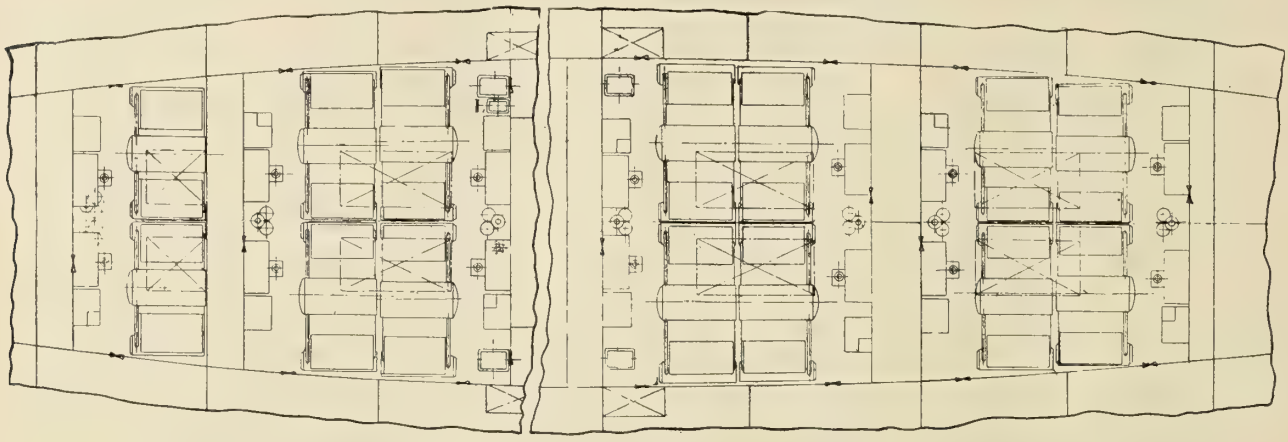


FIG. 2.—BOILER ARRANGEMENT OF THE S. GIORGIO.

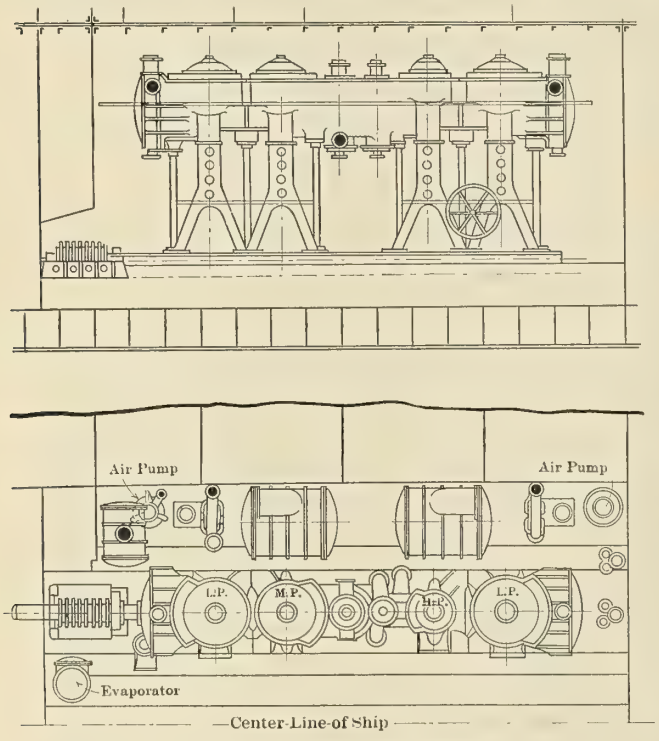


FIG. 3.—ENGINE ROOM ARRANGEMENT.

The diameters of the high-pressure, intermediate and each of the two low-pressure cylinders are, respectively, 34⅝ inches, 56 inches and 64⅛ inches. The stroke is 39⅜ inches.

The high-pressure and intermediate-pressure cylinders have piston valves of an average diameter of 20 inches and 30 inches, respectively, while the low-pressure cylinders have double-ported slide valves, with compensators at the back. Simple balance cylinders are fitted, both to the piston and to the slide valves.

The valve gear is of the Stephenson link-motion type. The reversing engine is of the all-round type. The pistons, cylinder covers, steam chest covers, bed-plate and columns are of cast steel, the pillars being of wrought steel.

The arrangement of cylinders from forward aft is: Low-pressure, high-pressure, intermediate-pressure, low-pressure. The distance between the forward low-pressure cylinder and the high-pressure cylinder is 43¼ inches; the same distance is between the intermediate and the last low-pressure cylinder, while the distance between the high and the intermediate is 150 inches.

The crank-shafts are of steel and hollow. Each is composed of two parts, and there are two cranks on each part. Each crank-shaft has six main bearings, four of which are 24 7/16 inches and two 29 inches in length. The outside and inside diameter of the crank-shafts in the bearings are, respectively, 16⅛ inches and 8 inches. The diameter of crank-pins is 16¾ inches, and their length 23¼ inches. The turning wheel is fixed on the coupling at the after end of the engine.

The length of the connecting rods is 86⅝ inches, and the minimum diameter is 8⅝ inches. The outside diameter of the piston rods is 8⅝ inches. The outside diameter of the pillars is 7⅛ inches. The main steam pipe is 12⅜ inches in diameter, and the diameter of the two pipes between the high and intermediate-pressure cylinders is 13⅜ inches. Four 13⅜-inch pipes bring steam from the intermediate-pressure cylinder to the two low-pressure cylinders.

The diameter of thrust shaft is 16⅛ inches outside and 8 inches inside. Each thrust shaft has eight collars, with a thrust surface of 15½ square feet. The screw shafts have a diameter of 16¼ inches. The propellers are of manganese bronze with three blades each. Their diameter is 15 feet 9 inches, the mean pitch 17 feet 8 inches, and the developed surface 63 square feet.

There are four main condensers, two for each engine-room, with a total cooling surface of 19,375 square feet. In each engine room the circulating water is supplied by two centrifugal pumps, driven by compound engines. Each pump is capable of delivering the circulating water to each of the two condensers no hot well, the air pumps delivering into the feed tanks directly.

There are fourteen "Blechynden" watertube boilers, arranged in four compartments, situated eight forward and six aft of the engine room. The total heating surface is 49,794 square

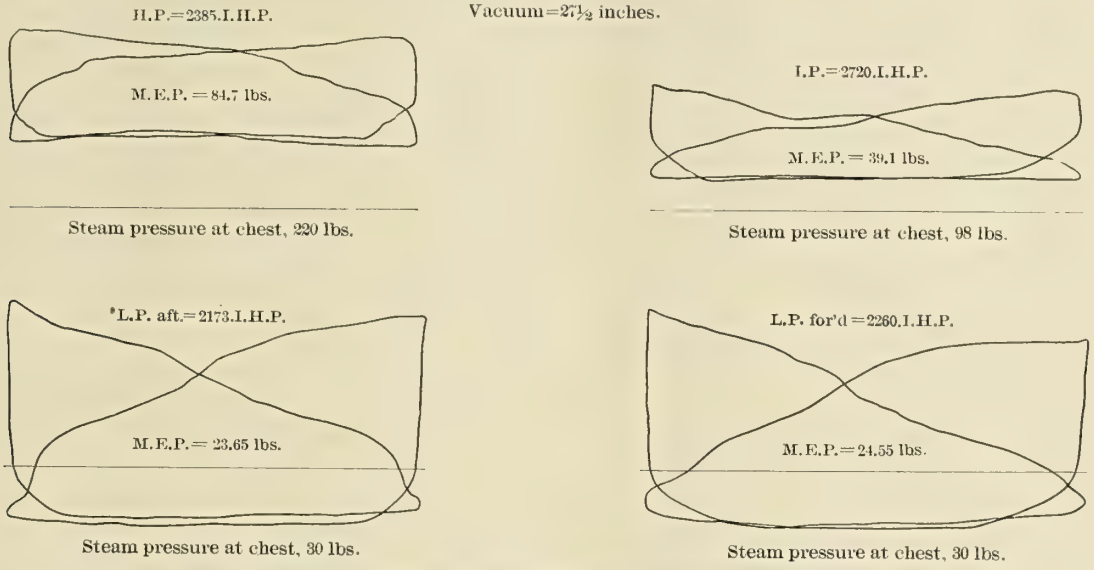


FIG. 4.—INDICATOR CARDS FROM THE ENGINES OF THE S. GIORGIO.

independently or to both of them, and to draw from the bilges 1,000 tons of water per hour. There are in each engine room, also, two single air pumps of the Weir type. There is also in each engine room an auxiliary condenser of 10,764 square feet.

The revolution counters are of the Molinari type. The other

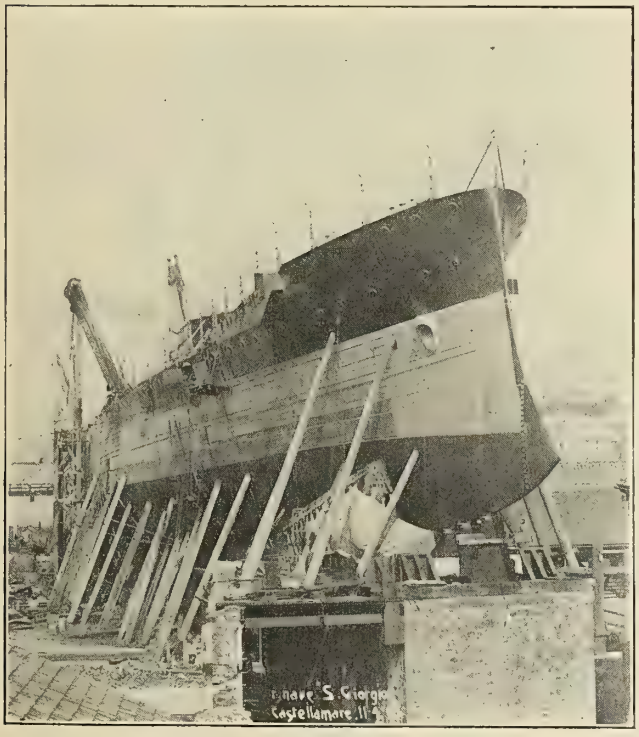


FIG. 5.—THE S. GIORGIO BEFORE LAUNCHING.

auxiliaries placed in the engine room are as follows: Two Ansaldo's evaporators complete with pumps, each capable of supplying 36 tons of fresh water during twenty-four hours; two independent bilge and fire pumps and four fans. There is

feet, and the total grate surface 1,314 square feet. There are four funnels, having a total area of 200 square feet.

Two Weir feed pumps are placed in each boiler compartment, each being capable of supplying the water necessary for all the boilers in its compartment. Forced draft of the closed stokehold system is obtained by means of fourteen fans. There are, besides, eight electrical ash hoists. The main and auxiliary steam pipes are of solid drawn steel.

The first and official full-power sea trial took place between Nalpes and Spezia Feb. 24 last. The speed measured while the ship was developing her maximum power (about 19,000 horsepower) was 23 knots, and the coal consumed 1¾ pounds per horsepower per hour.

THE MARINE STEAM ENGINE INDICATOR—XIII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

The engines having been warmed up and gradually worked up to full power the drum-spring tension should now be tried. Oil the drum spindle bearing and guide pulley, being careful not to grease the cord, if possible to avoid it. It is desirable that the tension should be as small as possible, and to this end the spring should be slacked well back. Put a card on the drum. With one hand pull down the hook on the drum cord as far as it will go. Catch the bowline in the other hand, so that it can be easily hooked on, and raise the bight or loop until the pull of the reducing motion can just be felt as the engine crosses the bottom center. With the loop adjusted, as before described, the point of the hook will reach a quarter of an inch or more beyond the top of the bowline, and the hook is engaged without difficulty. If the operation is conducted in the manner described, it makes no difference whether the engine is standing still or making 400 turns a minute, the connection is made with equal facility. The drum being in motion, apply the pencil to the card, gradually slacking off the swivel stop so that a faint, fine horizontal line is drawn. Unhook the cord. Have a small hook attached to some stationary part of the engine near the indicator. Throw the bowline over this

* Copyright, 1910, by Chas. S. Root.

hook, to keep it from whipping about on the grating. Remove the card from the drum, and measure the length of the line drawn. If the line is the same length as the one drawn when calibrating the reducing motion, the spring tension is correct. If the line is longer the drum has over-traveled, due to inertia. Increase the spring tension a little and try again. Repeat the operation until the over-travel is reduced to a minimum. By the time this operation has been completed a peculiar click will probably be noticed about the indicator each time the engine crosses the top center. If this is the case hook the forefinger over the bowline and pull the cord gently to one side. This shortens the cord, and if the drum is striking its stop on the top center the noise will cease. Unhook, shorten up the standing part of the cord (Fig. 86), and pull the turns around the shank of the hook. A hitch of this kind, while it will not jam under pressure, rarely ever slips; but if it should trouble by slipping make an additional hitch around the "standing part," as shown. The adjustments and tests now being complete, the actual work of taking the diagrams may be commenced.

TAKING THE DIAGRAM.

If possible, an indicator should be fitted to each end of the main engine cylinders, but the usual outfit furnished a ship provides but one indicator for each cylinder. Before attaching the indicators, blow the pipes and cocks out thoroughly, and have any water which may have been blown about the working station immediately wiped up. Attach the indicators to the cocks, line up, and hook on the cords to see that all is correct, and if found so unhook again. Have some filtered cylinder oil at hand in a wide-mouth bottle[1]. Oil the pencil motion with watch oil, dip the indicator piston in the cylinder oil, and allow the surplus to drain back in the bottle. Examine the working surface of the piston carefully. If there is any dirt in the oil it is easily seen on the bright metal surface. Put the pencil motion in place, and open the cock so that steam will enter the indicator and at the same time blow out of the small hole at the side of the cock. Place the finger on the pencil lever, just above its connection to the piston rod, and with a gentle pressure follow it up and down. The whole mechanism should work smoothly, and if the motion feels "gritty" the cause should be ascertained and removed before proceeding. The pencil motion being in good order, wash the hands; put a card on the drum and hook on the cord. As soon as the steam blowing out of the side vent of the cock appears to be dry turn the steam full on the indicator, setting the cock so as to close the side vent. Screw in the swivel head stop so that the pencil cannot touch the card. Then, swinging the pencil motion against the stop, slack away on the screw until a faint line appears on the card. If a three-way connection is in use, turn the three-way cock and take a diagram from the other end.[2] Shut off the steam, and after a few seconds' interval again apply the pencil to the paper and draw an atmospheric line. Be sure that all cocks are wide open when taking the diagrams.

Unhook the cord, remove the card and again turn on the steam to keep the instrument warm. If the preliminary card is good, with the lines faint but clear, proceed with taking the regular series of cards. If the sea is smooth and the engines turning steadily the pencil should be held on the paper during one revolution only, but if the engines are racing ever so slightly, or the load is at all unsteady, the pencil should be in contact for at least two revolutions. An observer should be stationed to read the receiver gages, clock and counter at regular intervals, and the counter should be read for the unit figure on even minutes, as denoted by the second hand of the watch or clock. An observer should be at each cylinder in charge of the indicators on that station. The diagrams should be taken in sets, one from each end of each cylinder. All the cards of a set should be taken at the same time and they should all bear the same number, the sets being numbered consecutively. The observer at the gage should keep track of the "set numbers" and fix the time for taking. As soon as all of the cards of a set are taken they should be removed and numbered and blank cards fitted to the drums. The drum end should be examined for chafe, and if distress is apparent at any point the chord should at once be renewed in order to be ready for the next set. If the trial is of long duration, the top of the pencil lever at a point over the piston rod should be frequently felt in order to detect any fouling of the piston. If fouling is indicated remove the piston at once, wipe it off with cloth—not water—and dip it in the cylinder oil. It is convenient to have a clean box on the grating[3] for each observer to keep his gear in. A rough partition can be made near one end. In the narrow compartment thus formed the diagrams and blank cards can be stowed. In the main part of the box should be some waste, clean rags, a spare coil of stretched indicator cord, a cylinder oil bottle, a typewriter squirt can filled with watch or other fine oil and last, but not least, an old glove for use if it becomes necessary to handle any of the instruments while they are hot. The indicators on the high-pressure engine are the hardest to operate correctly, owing to the high pressures and excessive heat, and the most experienced man on the staff should take that station instead of going to the low-pressure, where the "old hand" will usually be found. Cards covered with greasy finger marks show bad workmanship, and the hands should be washed every time a diagram is taken if this be necessary for the production of neat work.

CARE OF THE INDICATORS.

When finished with the indicators remove them and plug the cylinder cocks. Remove the bowline, dry it and coil it down in the bottom of the box belonging to one of the indicators which is used on the corresponding cylinders. Wipe out the indicator cylinder with a soft cloth or tissue paper, using a soft pine stick to reach the bottom. Remove the piston and spring from the rod. Clean the pencil mechanism and pay particular attention to the piston rod where it passes through the cylinder cover. Spread a piece of clean cloth on the medium-pressure valve chest cover, place the instrument and its various parts on the cloth, fold one side of the cloth over all and make fast to the cover studs, so that there will be no danger of anything falling. After an hour in this position all of the moisture which has escaped the wiping will have disappeared. Grease all the steel and unplated brass parts, including the cylinder walls and piston and put the instrument together with the exception of the spring. This should be kept on its peg in the box. If the indicator is to be used often the writer prefers to keep the springs in a small vial of light mineral engine oil. The springs must be kept free from rust. Corrosion reduces the size of the wire, thus changing the scale, and scouring or scraping still further reduces the size. When all parts are properly prepared place the instrument carefully in its box. If the tray does not go down so as to permit the cover to close easily, the tray should be removed and the instrument properly placed. The box will hold everything that came in it without any forcing. Keep the box locked. If the indicator is not used again for several weeks it should be well wiped out with gasoline or benzine and freshly oiled before using again. This removes any gum that may have formed and presents it for use in good condition.

(To be continued.)

[1] A small vaseline bottle is excellent.

[2] It is a good plan to take a preliminary card from the top end of each cylinder only. Make these cards with a big T and the scale of the spring. These data need not be marked on any other card of the set until the work is finished.

[3] A wooden soap box without a top is excellent.

Test of Thornycroft Boilers, Fuel-Oil Apparatus and Fire-room Fans on Torpedo-Boat Destroyer Roe.*

BY C. F. BAILEY.

On April 14, 1910, tests were made at the works of the Newport News Shipbuilding & Dry Dock Company to note the working of the Thornycroft boilers, fuel-oil burning apparatus and the fire-room forced-draft fans installed on the torpedo boat destroyer *Roe*.

The installation for the ship consists of four boilers of the Thornycroft type, built by the Newport News Shipbuilding & Dry Dock Company, two being installed in each fire-room. Each boiler contains 4,500 square feet of heating surface. The boilers are fitted for oil burning only.

The oil-burning apparatus in each fire-room includes twenty-two oil sprayers and two oil heaters of the Thornycroft type, built by the Newport News Shipbluilding & Dry Dock Company, each having 66.7 square feet of heating surface.

The steam pumps are of the Davidson make. In each fire-room there is one light-service oil pump of the vertical simplex type; size, 6-inch steam cylinders, 7-inch oil cylinders by 12-inch stroke, for pumping oil from the bunkers to the tanks abreast the boilers. There are two fuel-oil pressure pumps of the vertical duplex type; size, 4½-inch steam cylinders, 2¾-inch oil cylinders by 6-inch stroke, which draw from these tanks and discharge through the heaters to the burners. There are two main feed pumps installed in the engine room, of the vertical simplex type, with 14-inch steam cylinders, 10-

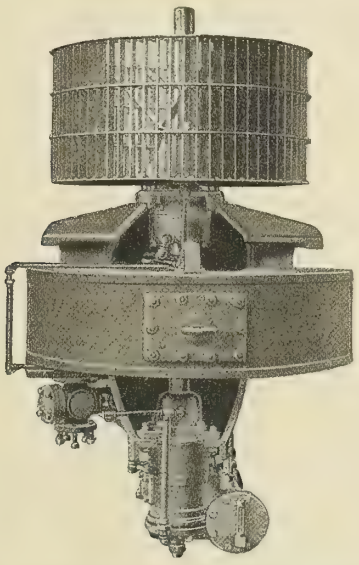


FIG. 1.—TERRY STEAM TURBINE AND SIROCCO FAN.

inch water cylinders by 12-inch stroke. There is one combined air and circulating pump with 6-inch steam cylinder, 8-inch air cylinder, 8-inch water cylinder by 8-inch stroke. There are several other pumps not used in the test which are not listed.

The auxiliary condenser contains 250 square feet of tube surface. It is fitted with ordinary ⅝-inch tubes, No. 18 B. W. G. thick.

The forced-draft fans were furnished by the Terry Steam Turbine Company, and are of the Sirocco type built by the American Blower Company. Each fan is direct connected by a vertical shaft to a Terry steam turbine, as shown in Fig. 1. The fans are 30 inches in diameter by 15½ inches width of runner. The distributor is stationary, and is of the form indicated in Fig. 2. The fans were designed to furnish 23,000 cubic feet of air per minute, against a pressure of 5 inches in the fire-room when running at 1,400 revolutions per minute. The bearings are oiled by a system of forced lubrication, which is self-contained in the unit. Each fan engine is provided with an emergency trip valve to stop the engine in case of accident causing excessive speed. For the purposes of the test the two boilers in the forward fire-room were used, together with the blowers and fuel-oil apparatus installed in this fire-room. Water for the boilers was taken from the city water mains and measured in tanks. As the tanks were filled they were

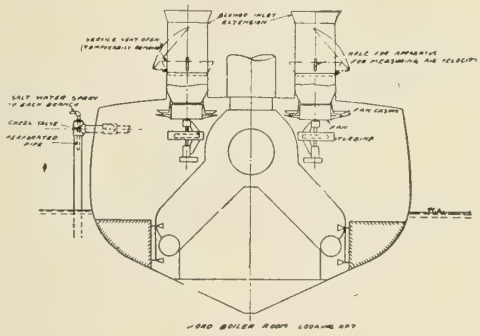


FIG. 2.

emptied alternately into the feed tank, which was provided with a tight cover and air pipe. One of the main feed pumps in the engine room was utilized to draw from the feed tank and to discharge through the feed-water heater to the boilers.

Steam from the boilers was used for running the two forced-draft blowers, the main feed pump, the auxiliary air and circulating pump, the oil heater and the oil pumps. Live steam was also used for the feed-water heater. The balance of the steam was passed through a 4-inch valve in the engine room, and thence through 7-inch pipes overboard. These pipes were carried below the water, and in the top of each pipe was introduced a 2-inch salt-water spray with perforated nozzle to act as a partial condenser for the steam. A small check valve was installed in each of these pipes to break the vacuum when shutting down. An additional 3-inch pipe was fitted overboard from the main steam, but at no time was it found necessary to use this pipe excepting for a short interval in test No. 4, and it is probable that the 4-inch valve would even then have cared for the total discharge. The 4-inch valve was regulated to maintain about 250 pounds at the boilers. A Barrus throttling calorimeter was placed in the main steam just before it entered the 4-inch valve in the engine room. The calorimeter was not lagged, and due to this and its distance from the boilers the quality of steam was probably better than indicated. The arrangement of disposing of the steam worked satisfactorily and with very little noise or vapor. A gage installed in the discharge to the 7-inch pipes from the 4-inch valve showed no pressure during most of the test.

The exhaust from the blowers was run to the auxiliary condenser in the engine room. The drain from this condenser was pumped to barrels on deck, where it was measured to determine the amount of steam used by the blowers. Live steam in the fire-room was taken to the oil heater, and the drain from this heater was taken through a drain collector provided with a gage glass, and from thence was conducted into barrels on deck, care being taken to keep the height of the water in the drain collector such as to prevent steam from blowing through.

Extensions were made to each of the blower inlets, and air-measuring apparatus, consisting of Pitot tubes, was installed in connection with the starboard ventilator to determine the velocity of air down the ventilator, as indicated in Fig. 2. The amount of air handled by the port blower was estimated from a comparison of the revolutions of the port and starboard

* From the Journal of the American Society of Naval Engineers.

SUMMARY OF TESTS OF BOILERS AND BLOWERS U. S. T. B. D. ROE.

Test No.	Time.	Duration, minutes.	Air press. in F. R., in ins. of water.	Temperature.					Boiler st'm gauge pressures.		Blowers.					
				Outside air.	Fire-room.		Stack.				Steam Pressure.		Exhaust Pressure.		R.p.m.	
					Above.	Below	Forw'd.	Middle.	For'd.	Aft.	P	S.	P.	S.	P.	S.
1	8:31 9:41	70	1.2	61	87	94	...	...	242	246	70	69	—7"	—6.3"	805	767
2	10:05 11:05	60	2.15	62	83	91	820	810	241	246	142	148	3.0*	4.7	1,106	1,056
3	11:20 11:50	30	3.0	63	88	95	840	850	245	249	223	225	11.9	14.0	1,348	1,275
4	12:05 12:35	30	3.25	70	90	97	860	860	250	255	245	249	14.8	17.0	1,389	1,333
5	12:45 1:10	25	3.2	72	90	97	850	890	249	254	241	248	14.3	16.8	1,357	1,285

Test No.	Fuel-oil press.		Fuel-oil temp., degrees.		Steam pressure at oil heater.	R.p.m., oil pump.	Opening of burners in turns.	Fuel oil used, lbs. per hour.		Veloc. air, in feet per min., in starboard vent.	Cubic feet of air per minute to blowers.			Cubic feet air per pound oil	Temp. in feed tank.
	To filter.	From filter.	From settl'g tank.	From heater.				Total.	Per sq. ft. H. S.		Starboard.	Port.	Both.		
1	158	143	69	231	205	30.7	.35	5,240	.58	...	...	...	...	...	68
2	185	174	68	229	225	48.4	.6	6,780	.75	2,080	18,150	18,750	36,900	327	60
3	187	169	67	221	241	55.2	.95	...	...	2,410	21,040	22,250	43,290	...	59
4	177	169	70	213	250	59.0	1.1	8,400	.93	2,483	21,680	23,050	44,730	327	59
5	175	165	70	210	250	58.8	1.2	9,760	1.08	2,465	21,540	22,450	43,990	271	59

Test No.	Temperature feed water.	Per cent. dry steam	R.p.m., main feed pump.	Aux. cond.		Pounds of water evaporated per hour.	Actual evaporation per		Factor of evaporation.	Evap. from and at 212 degs. per		Fuel-oil heater.		Per cent. water used by oil heater.
				R.p.m., pump.	Vacuum or press., ins.		Square foot heating surf.	Pound oil.		Square foot heating surf.	Pound oil.	Pounds steam used per hr.	Lbs. oil heated per lb. steam.	
1	199	97.4	25.0	68	16.7	72,500	8.05	13.8	1.07	8.65	14.9	547	9.6	.75
2	199	97.4	23.8	74	23.6	76,700	8.53	11.3	1.07	9.16	12.1	688	9.9	.89
3	190	97.3	28.0	78	20.2	94,200	10.46	...	1.08	11.34	...	820	...	.87
4	187	97.6	28.4	78	19.1	102,700	11.4	12.2	1.09	12.41	13.3	853	9.9	.83
5	177	97.8	29.2	78	19.2	104,800	11.64	10.7	1.10	12.79	11.8	866	11.2	.83

blowers. Each blower did its work well, and ran without heating, and with very little vibration or noise, and from observations it was apparent that each fan was doing its proper amount of work.

The fuel oil was measured by noting the height of the oil in the gage glasses on the oil tanks abreast the boilers. This was not thoroughly satisfactory in some of the tests, and the results are, therefore, not entirely consistent.

The fuel oil used was commercial oil, known as Illinois and Kansas crude.

Specific gravity, at 60 degrees F.	0.88
Degrees Baumé, at 60 degrees F.	30.0
Flash point, degrees F.	293.0
Calorific value by Mahler calorimeter, B. T. U.	19,522.0

Tests were run at varying air pressures, and the results are tabulated in the summary of tests. The oil supply was regulated to suit the combustion by adjusting the burner openings to show a slight haze of smoke, to make sure that an excess of air was not being used. The burners could have been easily run to show no smoke at the funnel, but this was not done, owing to the excess of air which might thus be heated and wasted.

Test No. 5 was run with an excess of smoke, the burners being 1.2 turns open instead of 1.1 turns open, as in Test No. 4. This was done to note if a gain in evaporation could thus be obtained. As will be seen by the summary of tests the total evaporation was slightly increased, but at the expense of an excess of oil. During the tests only one heater and one pressure oil pump were in service.

It is to be noted that with the vessel steaming ahead the power required of the fire-room fans will be reduced, and consequently the amount of air and pressure which can be obtained will be considerably increased, owing to the scoop effect of the ventilators, which will assist the fans.

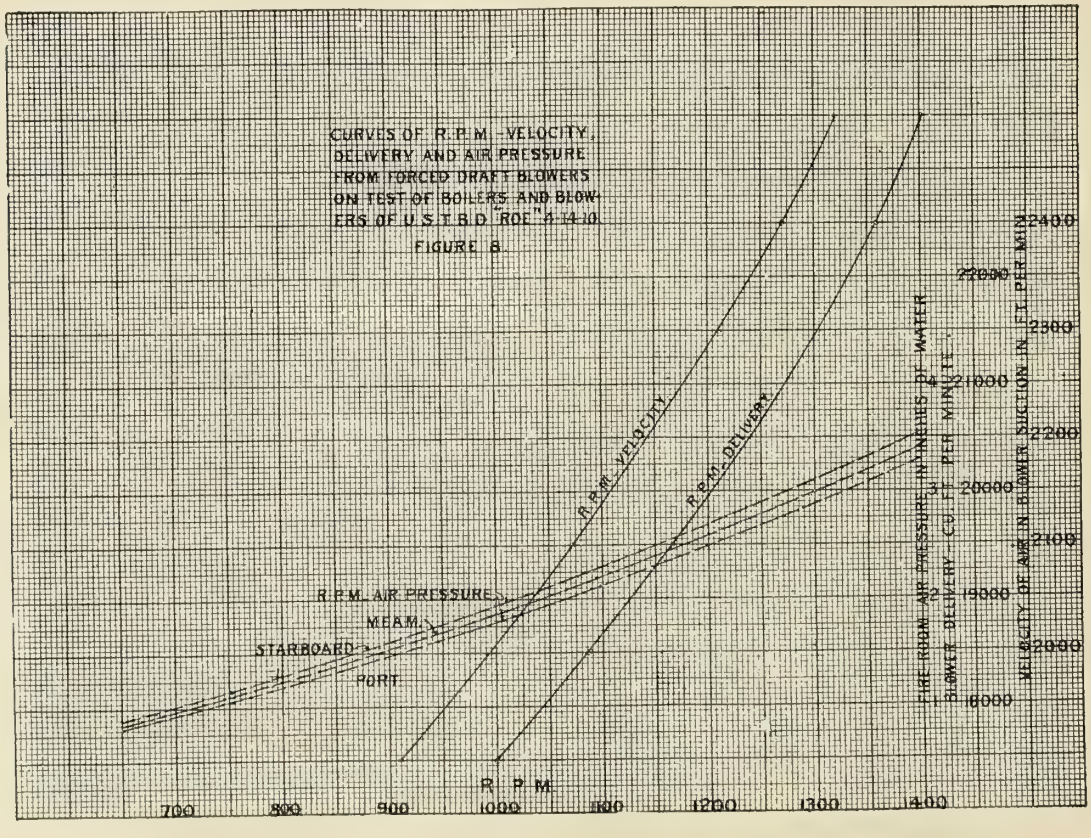


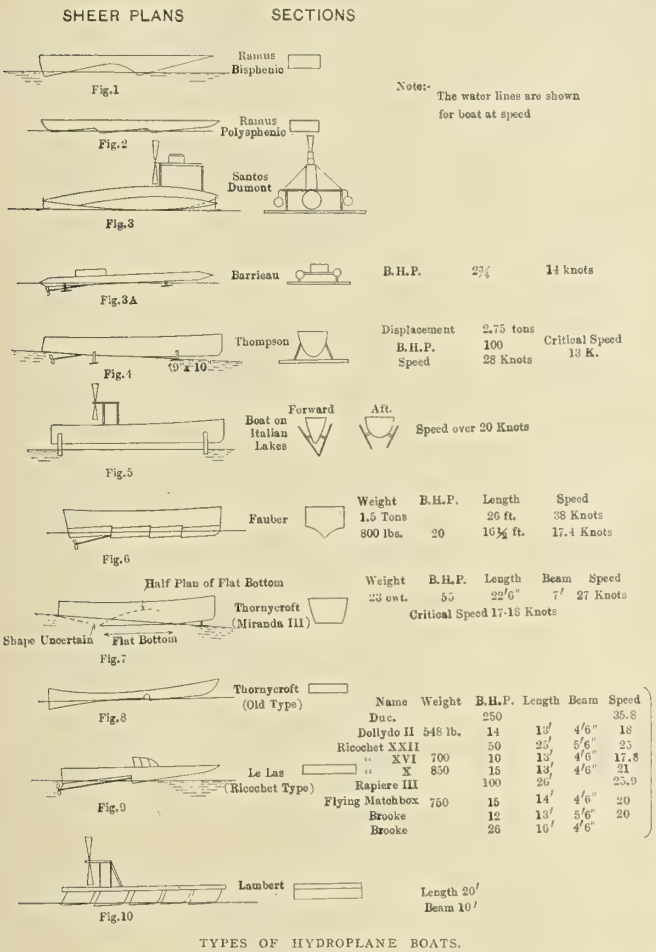
FIG. 3.—CURVES OF R. P. M., VELOCITY, DELIVERY AND AIR PRESSURE FROM FORCED-DRAFT BLOWERS OF U. S. T. B. D. ROE.

The operation of the fans, boilers and oil-burning apparatus demonstrated that the outfit is capable of supplying ample steam for the power necessary to drive the vessel at the contract speed, and the ease of control and the satisfactory working of the apparatus was such as to indicate that the installation will prove economical and successful in service.

THE HYDROPLANE BOAT.

Although this type of boat has, commercially speaking, little value, the high speeds obtained by quite moderate powers (compared with boats of ordinary shape) render it interesting to all naval architects.

The idea of eluding resistance by "skimming" the surface of the water is probably very old; the earliest authentic records, however, show that the credit of first exploiting the idea belongs to an English clergyman, Rev. Ramus. Figs. 1 and 2



TYPES OF HYDROPLANE BOATS.

show his boats. These, for want of a light source of power (A. D. 1870) were propelled by rockets, and a speed of 63 knots was once obtained.

Generally speaking, a hydroplane consists of a hull carrying two or more surfaces; in some boats incorporated with the hull and in others attached below, the surfaces have a slight general inclination, and in a few cases slight curvature. The planes, when separate from the hull, are of small dimensions in the fore and aft direction and large in the transverse. Not less than two planes is the general rule—this to obtain longitudinal stability.

GENERAL THEORY.

The reasons why a hydroplane boat has less resistance than an ordinary boat of the same weight may be understood from the following brief outline of the theory:

The waves thrown up by a boat of ordinary shape in its passage through the water are of two main types: (1) Transverse; (2) diverging. If the boat is short and the speed comparatively high, the waves set up are in case of (1) so far astern, or in case of (2) have receded so far from the boat that the energy spent in their creation is completely lost.

In the hydroplane boat, however, only the lower portions of planes are touching the water, the approximate relation between the weight of boat, speed and wetted area being

$$W = 3\ A\ V^2\ \Theta.$$

Θ being angle of inclination of planes. When the boat is "skimming" the pressure is suddenly applied to the water, and is immediately released—the water tending at first to move outwards from the bottom of the boat in all directions. That flowing forward reduces the relative velocity of the boat and water—that flowing aft quickly passes the step, while the water displaced in an athwartship direction tends to form waves parallel to the fore and aft line.

Immediately the plane has passed the pressure is relieved; the waves, therefore, have no time to grow to any size, and the energy spent in their creation is partially returned.

TYPES OF BOATS.

It will be quite impossible within the limits of one article to describe in detail all the types of hydroplane boats in existence to-day. These types lie in four main groups:

(*A*) Boat-shaped hulls carrying attached planes:
- (*i*) Flat planes. (*ii*) V planes.
- Santos-Dumont, Fig. 3. Italian boat, Fig. 5.
- W. B. Thompson, Fig. 4.
- Barrieau, Fig. 3A.

(*B*) Boat-shaped hulls with planes incorporated:
- (*i*) Fauber, Fig. 6.
- (*ii*) Thornycroft, Fig. 7.

(*C*) "Skimming-dish" hulls with planes incorporated:
- (*i*) Ramus, Fig. 1.
- (*ii*) Thornycroft (old type), Fig. 8.
- (*iii*) "Ricochet," Fig. 9. This is a popular type.
- (*iv*) Count Lambert, Fig. 10.

(*D*) Adjustable plane boats. There are several patents—no records of results.

(*E*) Freak boats. These are combinations of aeroplanes with hydroplanes—no practical success recorded.

There are numerous problems still unsolved in connection with hydroplanes. It will be seen at once that the ordinary stability calculations do not hold, and it is a fact that transverse stability is not easy to obtain. Fauber's boats are shaped to get more stability, and, of course, will do so if the vertical component of the dynamic pressure cuts the middle line plane above the center of gravity when the boat is inclined. Stability gained in this way must be at the expense of speed.

Even in calm water "pounding" is a source of trouble, and in some boats the occupants sit on spring seats. This is obviated by giving a boat-shaped bow to several types. Other interesting problems are:

(*a*) What is the minimum critical speed for "skimming"?
(*b*) Inter-relation between weight, speed and power?
(*c*) Position of "step"?
(*d*) Type of propellers and best position for them.

Fig. 11 shows the stream lines under a "Ricochet" type of boat below the critical speed. E. C.

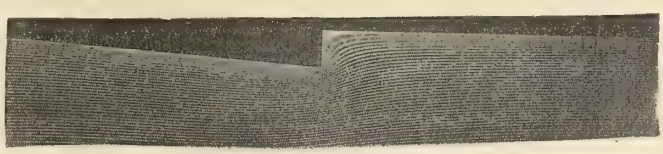


FIG. 11.

OIL FUEL INSTALLATION ON STEAMSHIPS YALE AND HARVARD.

The Metropolitan Line steamships *Yale* and *Harvard,* running between New York and Boston, have recently been equipped for burning oil fuel. These ships are among the first turbine-driven vessels built in the United States; each is 386 feet 6 inches long between perpendiculars with a molded beam of 50 feet 6 inches, a molded depth of 22 feet and a normal draft of 16 feet. They have triple screws, driven by Parsons turbines capable of developing 12,000 horsepower, giving the ships a speed of about 23 knots. The boiler installation in each ship consists of twelve single-ended Scotch boilers, 14 feet in diameter and 12 feet long, located athwartships in two separate boiler rooms. There are, therefore, three boilers on each side of each boiler room. The total grate area is 756 square feet, and the total heating surface 29,520 square feet. Each boiler has three corrugated furnaces, 42 inches diameter, leading to separate combustion chambers. There are 264 plain tubes, 8 feet 5 inches long by 2½ inches diameter, and 104 stay tubes of the same dimensions in each boiler.

These ships were originally designed for burning coal, and the fuel was carried in two athwartship bunkers, one forward and one aft of the boiler space. Two hundred and fifty tons of coal were ordinarily burned on the round trip between New York and Boston, and the fire-room force consisted of forty-eight men—thirty firemen and 18 coal passers. It usually required from four to five hours to coal a ship.

In changing over to oil fuel the entire space in the forward coal bunker has been gained for other purposes, while the after coal bunker is utilized as a pump room for the oil pumps, settling tanks, etc. The oil is carried in the cellular double bottom under the boilers. At each end of the double bottom under the boiler space an oil-tight cofferdam has been built one frame space wide. The oil tanks are also divided into four separate tanks by a watertight bulkhead between the two boiler rooms and by the center keelson. Although the use of the double bottom under the boiler space is not generally favored for fuel oil tanks, yet in the case of these ships it was practically the only available space for oil storage, and, furthermore, every precaution has been taken for safety. The entire tank top has been covered with 4 inches of concrete cement, which insulates the tanks from the heat of the boilers as well as seals them tightly, so that in case of any leakage it would be impossible for gases to escape into the boiler room. The combined capacity of the four tanks is 110,000 gallons.

The fuel is taken on board at the rate of 50,000 gallons per hour from barges which are brought alongside. A 6-inch in-take pipe leads to the main deck by way of a cargo door, where a hose connection is made with the barge. There is also a steam connection to supply steam to the barge, so that no tug is required when pumping the oil on board. Each of the four tanks has a separate 6-inch connection to the main filling line.

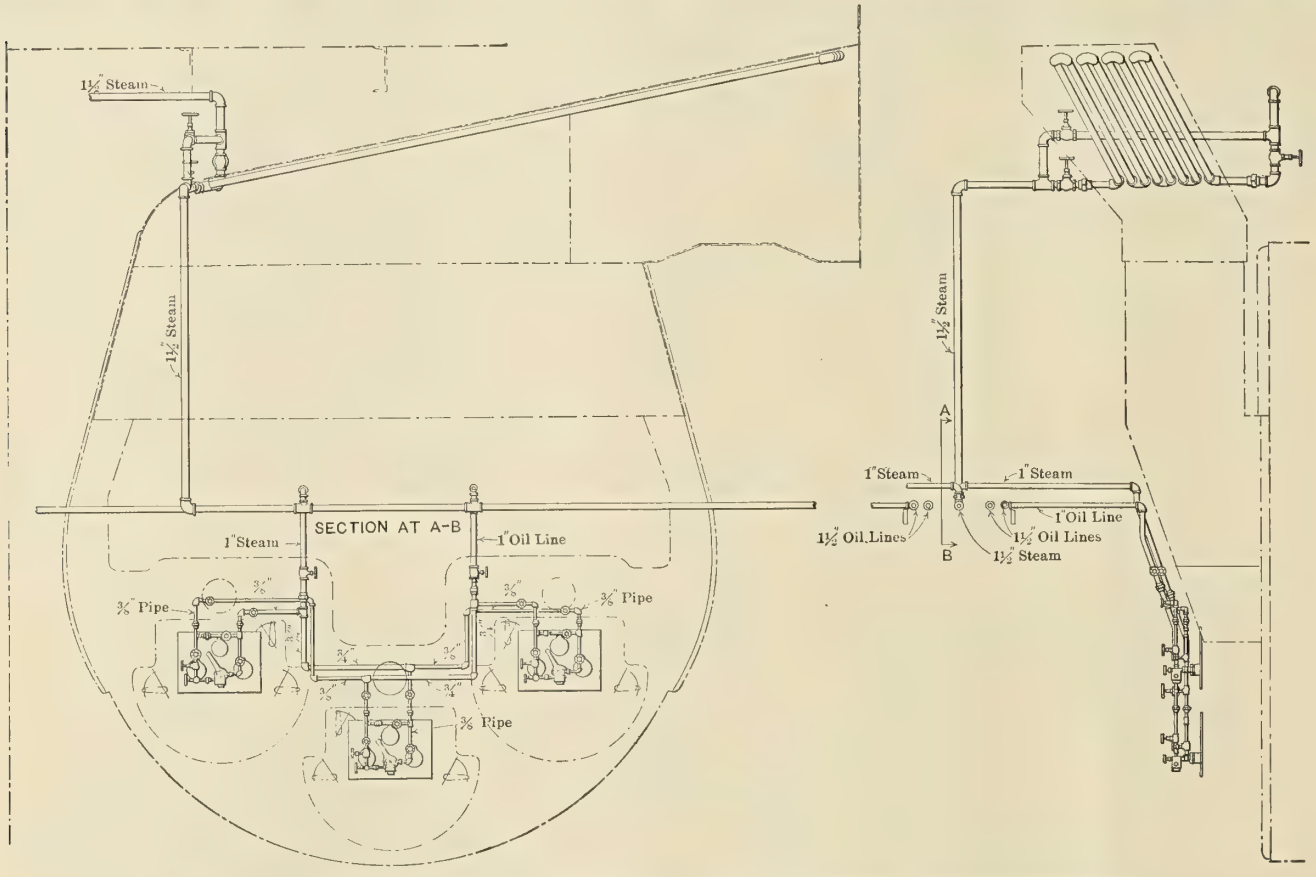


FIG. 1.—ARRANGEMENT OF PIPING, BURNERS AND SUPERHEATERS ON BOILERS OF THE HARVARD AND YALE.

An overflow valve is connected to the ventilating pipes, so that warning is given at the barge when the tanks are filled. A complete system of ventilation is supplied to the tanks whereby each has an open pipe leading from the highest point of the tank and connected in pairs to pipes which extend 20 feet above the hurricane deck on the forward side of the smokestacks. These vent pipes have mushroom-shaped covers at the top and a wire gauze protection to prevent sparks or hot cinders from entering the tanks.

The oil is pumped from each tank through 4-inch pipes, all of which lead to one valve manifold in the pump room. From here the oil passes through a suction strainer to the lift pump. The lift pump discharges into two settling tanks of 3,000 gallons capacity each. The combined capacity of these two settling tanks is sufficient for four hours' steaming in case of accident to the main tanks. The oil is allowed to settle in

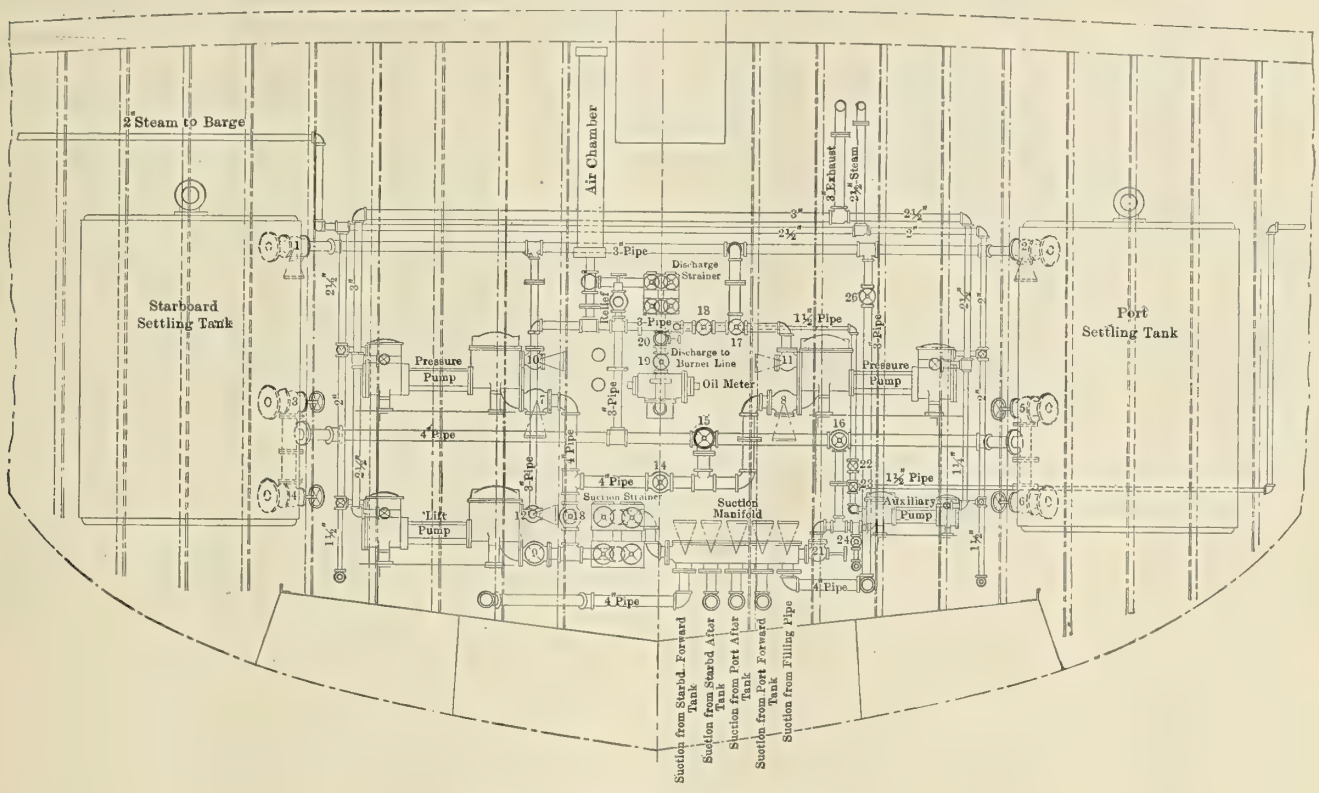


FIG. 2.—ARRANGEMENT OF PUMP ROOM.

one tank while being drawn from the other. The dirt and foreign matter in the oil are pumped overboard from the bottom of the settling tanks. A double set of oil-pressure pumps of the Warren special duplex type, 9 by 5¼ by 10 inches, draws the oil from the settling tanks at a point 4 feet from the bottom of the tanks, so that clear oil is always delivered to the burners. An extra suction is also provided at the bottom of the settling tank in case it becomes necessary to use all the oil in the settling tanks. The piping is so arranged that either pressure pump can be used as a lift pump or the lift pump can be used as a pressure pump, so that in case of accident to one of the pumps there will always be a spare pump available. In addition to this there is an auxiliary duplex 5¼ by 3½ by 5-inch pump for use in port where only one or two boilers are in service. The pressure pumps discharge to a strainer, so that the oil is strained a second time before passing to the burners. It then passes through a Worthington meter to the main pipe lines extending to the fire-room. On the main line is a valve with an extension valve stem to the main deck, so that in case of accident the entire fuel supply can be cut off without entering the boiler room.

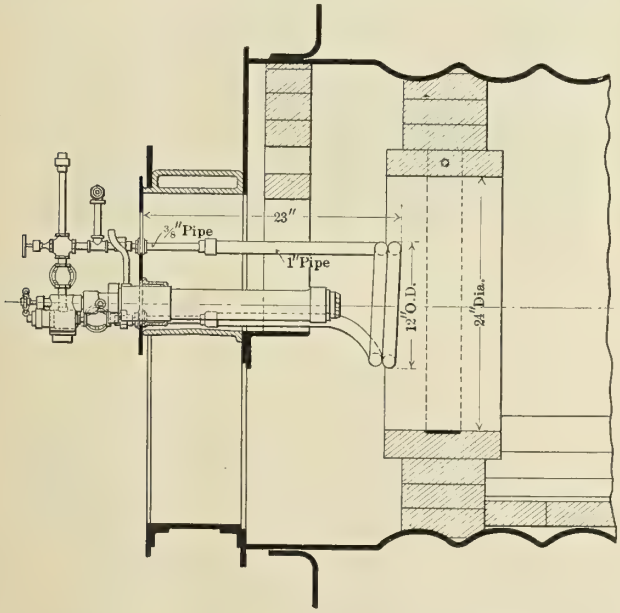


FIG. 3.—FURNACE ARRANGEMENT.

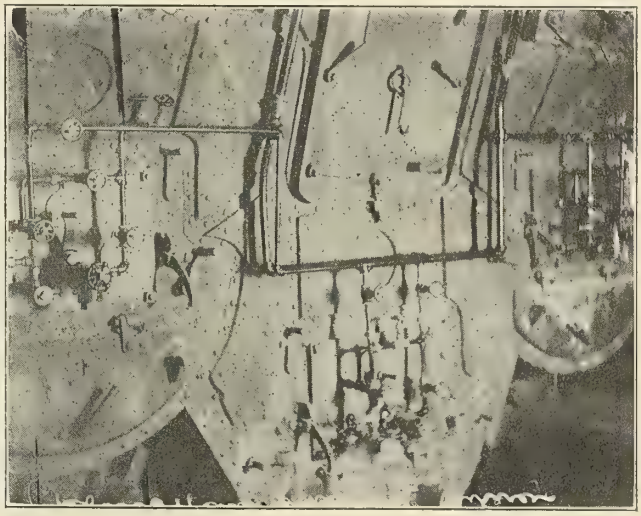


FIG. 4.—GENERAL VIEW OF ONE OF THE BOILERS WITH OIL BURNERS INSTALLED.

The oil is led to the fire rooms in four separate pipes, which are located, for safety, one on each side of each fire room. There is also on the discharge line in the pump room a large air chamber to insure uniform pressure on the pipe line. The oil pressure is from 110 to 120 pounds per square inch.

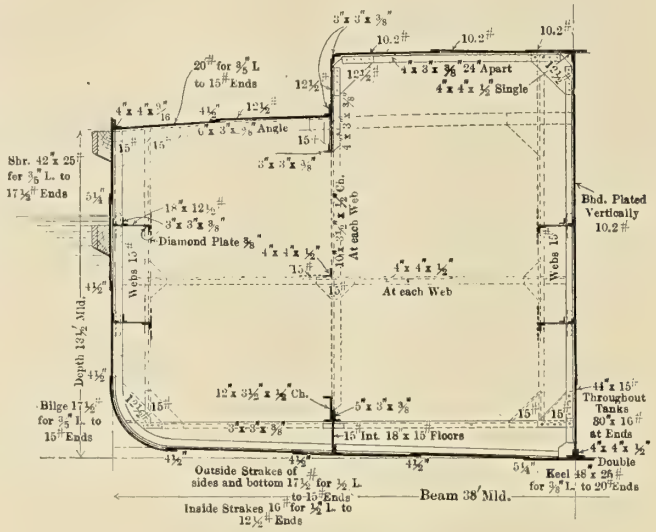
Each furnace is fitted with one 350-horsepower Lassoe patent burner designed for steam atomization. The oil is heated to a temperature of 350 degrees F., in an internal coil of 1-inch pipe, extending into the brick-lined mouth of the furnace, as shown

in Fig. 3. After passing through the coil the oil is delivered to the mixing chamber of the burner. The oil is atomized by means of superheated steam supplied at a pressure of from 100 to 110 pounds per square inch. The steam is superheated in coils placed in the up-takes of the boilers, as shown in Fig. 1.

The only changes made in the boilers themselves for the installation of the burners were the removal of the grate-bars, bearers, bridge walls and furnace doors. The mouths of the furnaces are now covered by a ⅜-inch plate, arranged as shown in Fig. 1.

The principal reasons for changing from coal to oil fuel on these vessels were that steadier steam pressure can be maintained, cleaning of fires is eliminated, and trouble with the fire-room force, which always exists to a greater or less extent on vessels on short runs, requiring a comparatively large number of men in the fire-room, is also eliminated. Besides these reasons there are a number of advantages which have been gained by the use of oil fuel which have resulted in economy. To make the run on schedule time it is necessary for the engines of these vessels to develop 10,000 horsepower. For one round trip, including port use, they consume 47,000 gallons of oil, the grade of oil used averaging 28 degrees Beaumé, weighing 7.38 pounds per gallon and having a flash point of not less than 180 degrees F. The fuel consumption with oil is 1.1 pounds per indicated horsepower per hour, as against 1.4 pounds per indicated horsepower per hour with coal. Only twelve men are now required in the fire-room force as against forty-eight which were required with coal. The cost of oil fuel is greater than that of coal, but the saving resulting from the reduction in the number of men in the fire-room force, in the lessened depreciation of the boilers, bunkers, tank top in the fire-room, and in the annual repairs to fire-room floor plates, ash guard plates and ash ejectors, and the saving in the renewal of fire bars, furnace castings, firing tools, etc., have been found to more than offset the increased cost of the fuel. Economies have also been effected in other directions, since when burning coal a force of eight men was kept at New York simply to clean boiler tubes, bilges, tank tops, etc., and also a force of twelve men was employed in cleaning the vessels from soot, cinders, in painting, etc. This work has been entirely eliminated, as well as the objectionable features of smoke, cinders, etc. Taking all these items into consideration it is estimated that by burning oil fuel a saving of $1,400 (£288) per month has resulted in the operation of both ships. It is expected that even better economy will result as more experience is gained in the use of oil fuel.

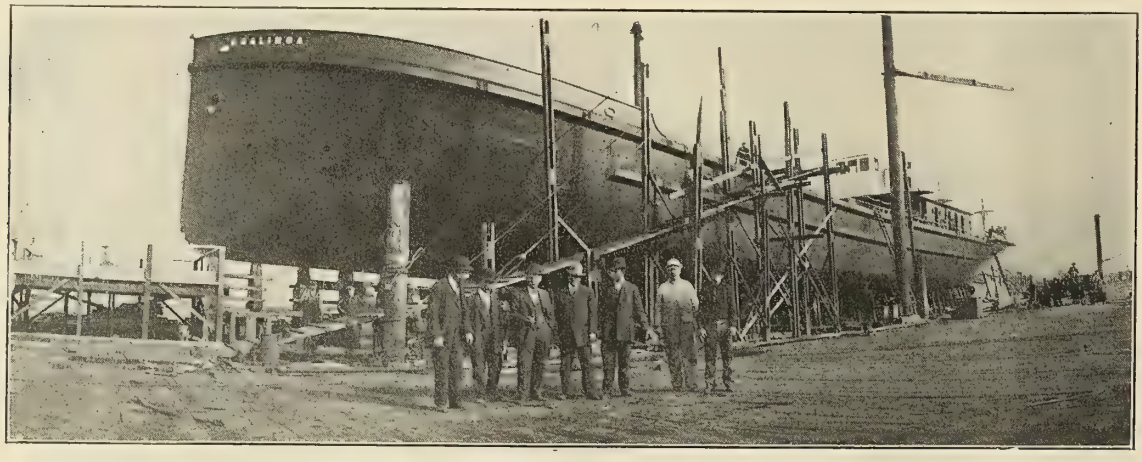
The installation was made by the W. & A. Fletcher Company, Hoboken, N. J., from plans and specifications and under the supervision of Robert McGregor, consulting engineer of the Metropolitan Steamship Company.



MIDSHIP SECTION OF THE COALINGA.

ASSOCIATED OIL COMPANY'S NEW STEEL OIL TANKER, COALINGA.

We print herewith the drawings of the first steel ship built in Oakland, California. The Moore & Scott Iron Works were the builders of the vessel, which is named the *Coalinga*. She is a steel tanker built for carrying oil in bulk, in six tanks arranged in pairs in the midship part of the vessel. The vessel burns oil for fuel and the fuel oil tanks are on each side of the vessel alongside the boilers.

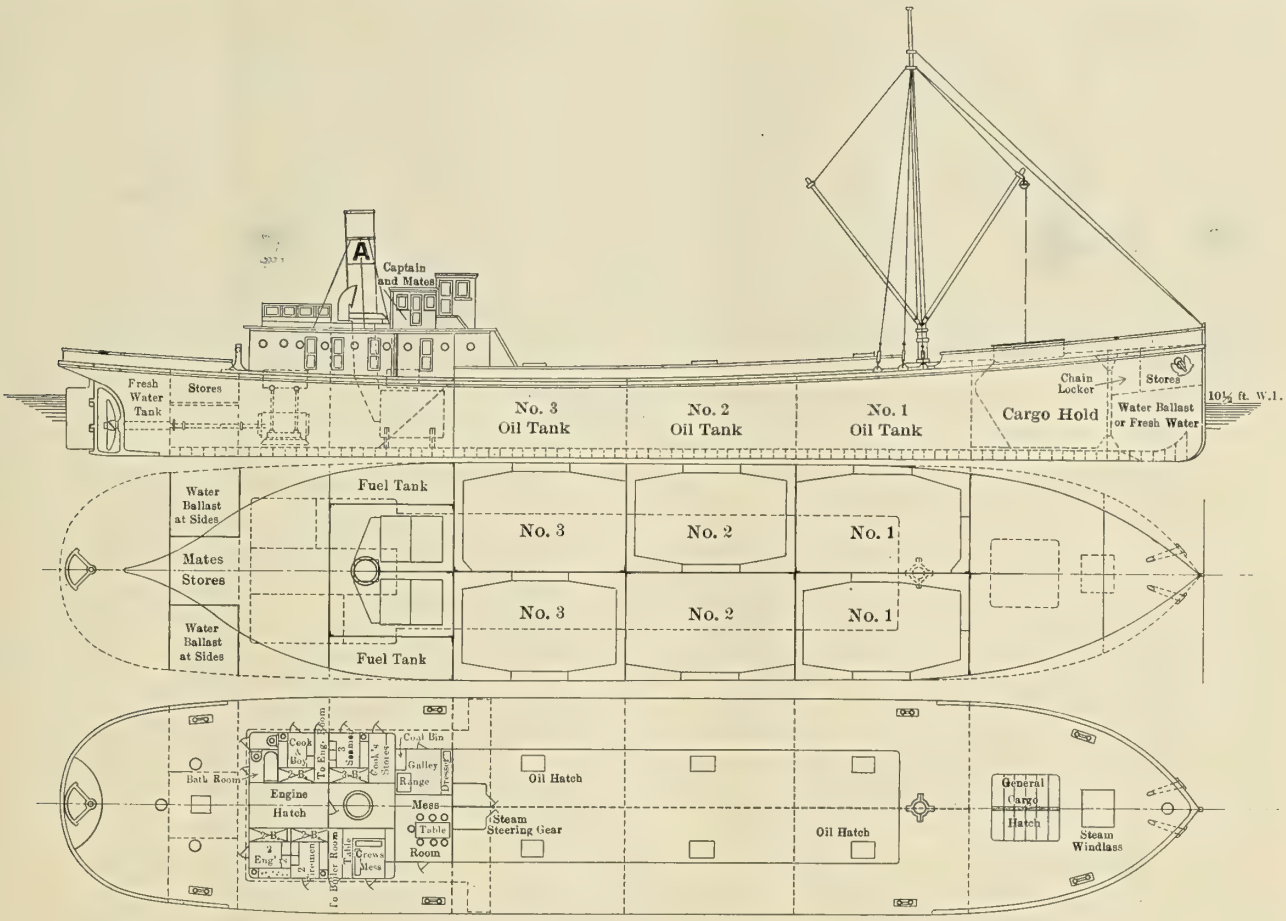


STEEL OIL TANKER BUILT ON THE PACIFIC COAST.

The principal dimensions are as follows:

Length over all	200	feet
Length between perpendiculars	194	feet
Beam molded	38	feet
Depth molded	13½	feet
Draft with 7,000 barrels of cargo	10½	feet
Total cargo carrying capacity	8000	barrels

The outline design for the vessel was prepared by the Associated Oil Company, from which the finished design was worked up by the Moore & Scott Iron Works, San Francisco.



INBOARD PROFILE, DECK AND HOLD PLANS OF THE COALINGA.

The vessel is a single deck model without poop or forecastle, with a steel house over the engine and boilers, housing the crew, on top of which is the wood pilot house and captain's room. Forward in the bow of the vessel is the storeroom and chain locker with the water ballast tank below them.

Between the collision bulkhead and the forward tank bulkhead is the pump room. Here is located all of the gear for handling the oil cargo of the vessel. The pipe line is run along each side with a valve to each tank operated from the deck above. A connection from this line also runs to the fuel tanks of the vessel.

The oil tank construction is laid out on the Dickie system, the main idea of which is the abolishing of all single riveted clips in any position whatever. There is not a clip or a bracket on the *Coalinga* that is not backed up by a clip or a bracket on the opposite side of the bulkhead, and the rivets are put through the three thicknesses. The result of this method of doing the work was that the entire tanks of the vessel were tested in eight days, being at the rate of one a day. This has never been done in the port of San Francisco before. Coupled with this system was the remarkably good workmanship of the Moore & Scott Iron Works, there being no unfair holes in the entire work, so fas as anyone knows.

The engine was built by the Moore & Scott Iron Works and is of the inverted cylinder, direct acting, compound type, with the high-pressure cylinder 14 inches diameter, low-pressure 32 inches diameter, with a common stroke of 24 inches.

The two main boilers are of the Scotch marine type, 8 feet 6 inches diameter by 10 feet 6 inches long, each with two Morrison furnaces 32 inches diameter, and with a working pressure of 160 pounds per square inch.

The oil burners are of the Staples and Piefer type, with duplicate system pumps 4½ inches by 2¾ inches by 4 inches duplex.

The vessel was launched April 30.

The Fast Steam Yacht Winchester.

The fast steam yacht *Winchester,* constructed for an American owner by Messrs. Yarrow, of Glasgow, is built on torpedo boat lines, her dimensions being as follows: Length, 165 feet; beam, 15 feet 6 inches.

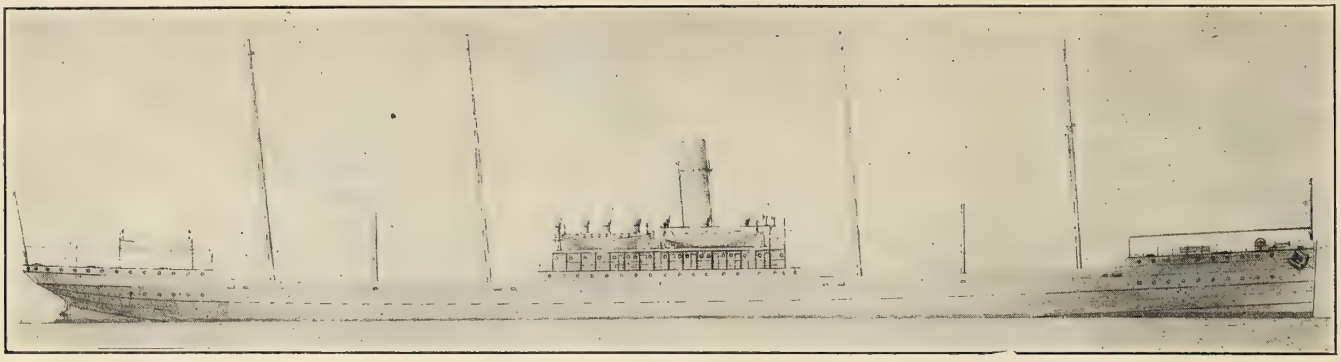
Her estimated speed was 26 knots, and the mean speed obtained on a two-hour trial 26.7 knots.

The propelling machinery consists of three turbines of the Parsons type (constructed by Messrs. Yarrow) with three shafts, one propeller on each shaft. The port shaft is actuated by the high-pressure turbine, the center shaft by the low-pressure turbine, in which is incorporated an astern turbine, and the starboard shaft by the intermediate pressure turbine.

Steam to the turbines is supplied by two Yarrow watertube boilers, constructed for burning oil fuel exclusively.

The accommodations for the owner, which are below decks, abaft the machinery space, are very commodious and handsomely decorated, consisting of a double stateroom, two single staterooms, a drawing room, bath room and toilet rooms. There is a teak deck house forward 25 feet long, containing the dining room, captain's cabin and pantry. The quarters for the officers and crew and the galley are below the main deck forward.

The vessel has a complete electric light installation and is heated by steam.



NEW DESIGN FOR A 19,200-TON NAVAL COLLIER.

DESIGN FOR A NAVAL COLLIER.

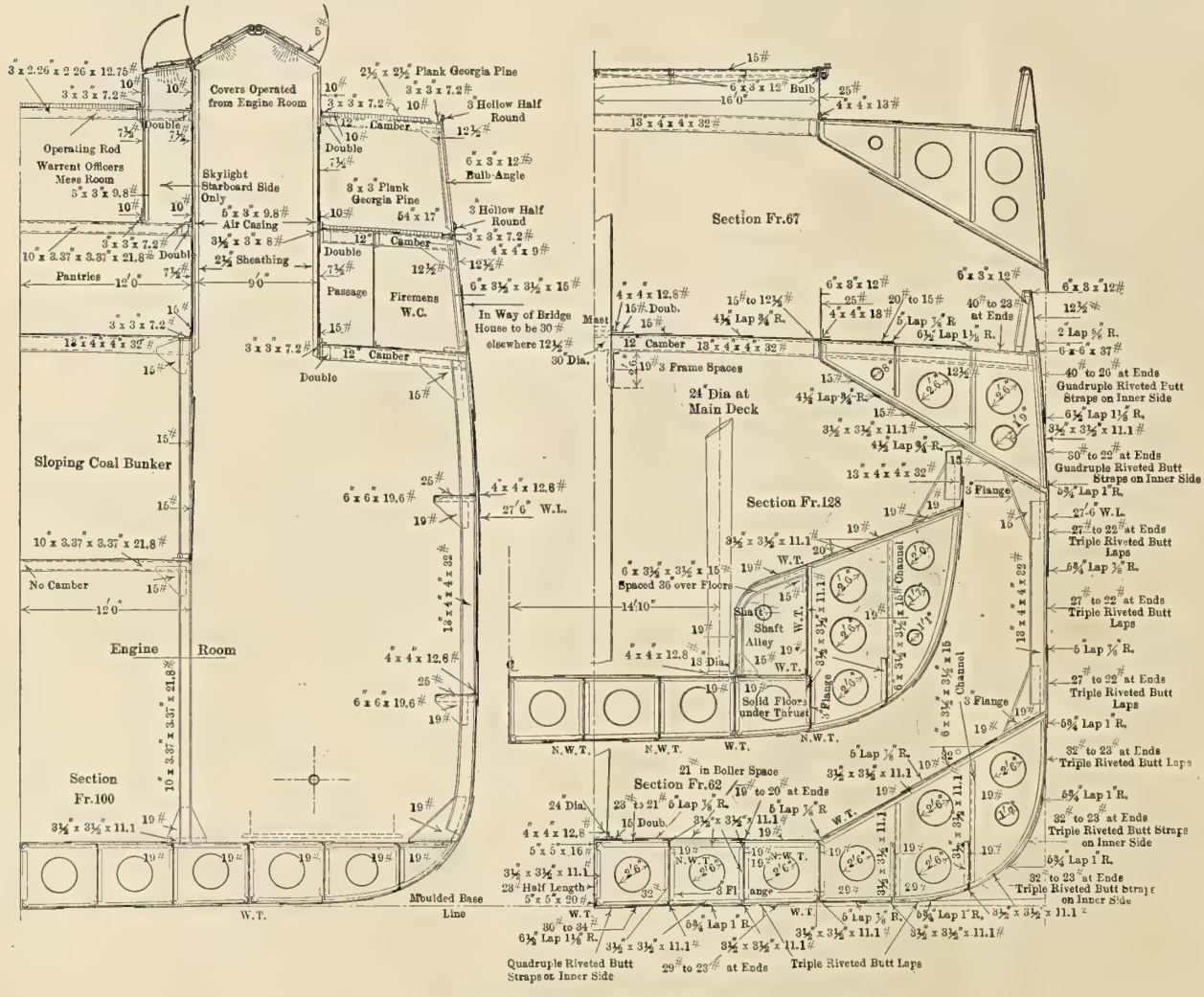
BY R. E. BARRY, ASSOC. I. N. A.

The vessel illustrated herewith has been designed by the writer to fulfil a few conditions which seemed desirable in a naval collier for supplying the fleet or a far-distant naval station. These conditions are that trim should not alter as fuel is consumed, the after holds should offer the same facilities for discharge that maintain forward, and in both all the cargo should come within reach of clam shell or other diggers, the coaling length of either the forward or after part of the deck should be as great as that of any naval vessel, and a method of transporting coal aft to a sea-coaling device should be provided. Also oil fuel for torpedo vessels should be a consideration of design.

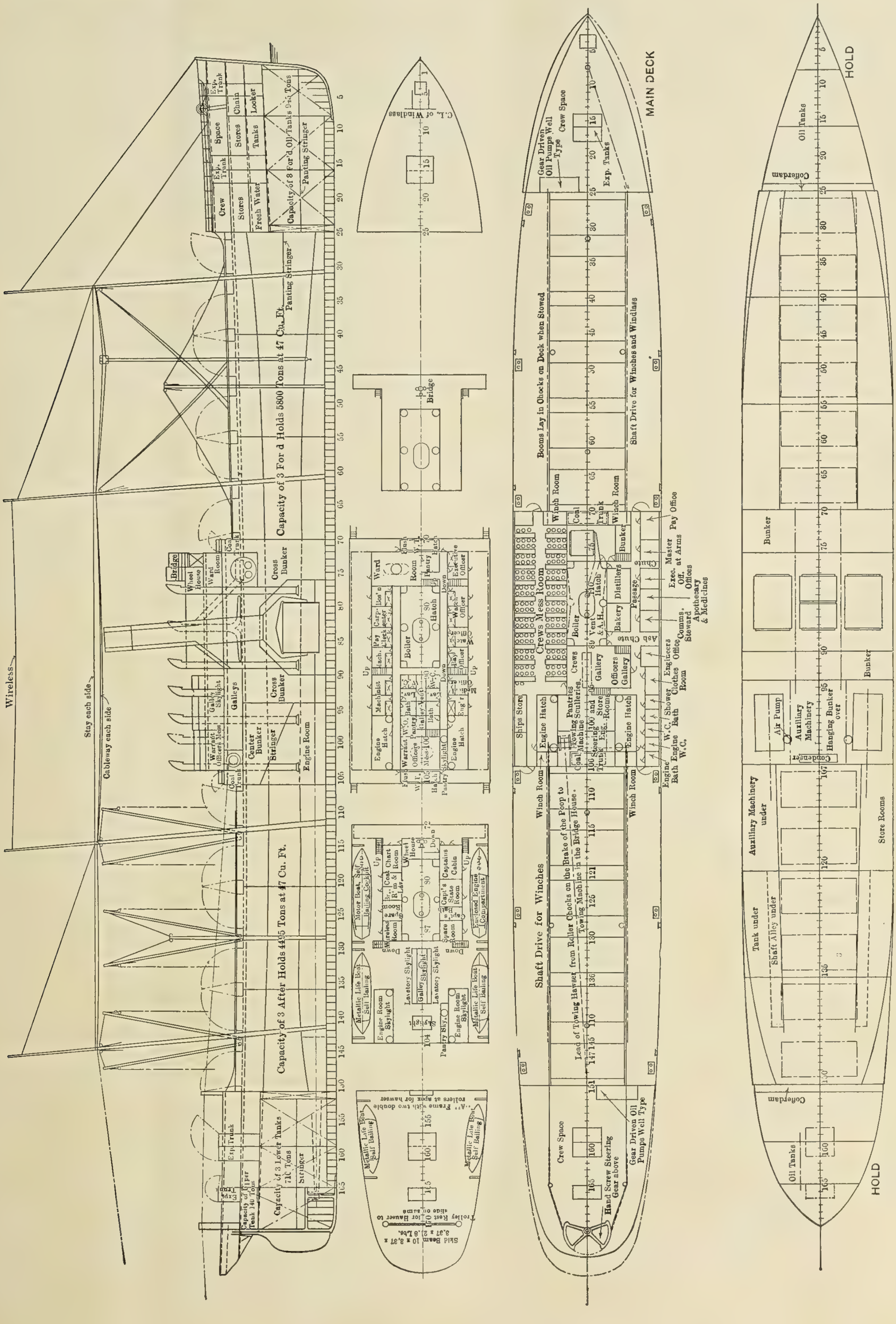
To maintain trim as usual in ocean-going vessels the fuel and machinery were placed amidships.

To avoid the obstruction of shaft tunnels in the after holds, which generally make three divisions of the lower holds, the engines were winged out as close to side of ship as possible, and the shaft tunnels thus came so far outboard that they could be fitted under the hopper sides, which are fitted both fore and aft, to cause coal to come under the hatches as it is dug out.

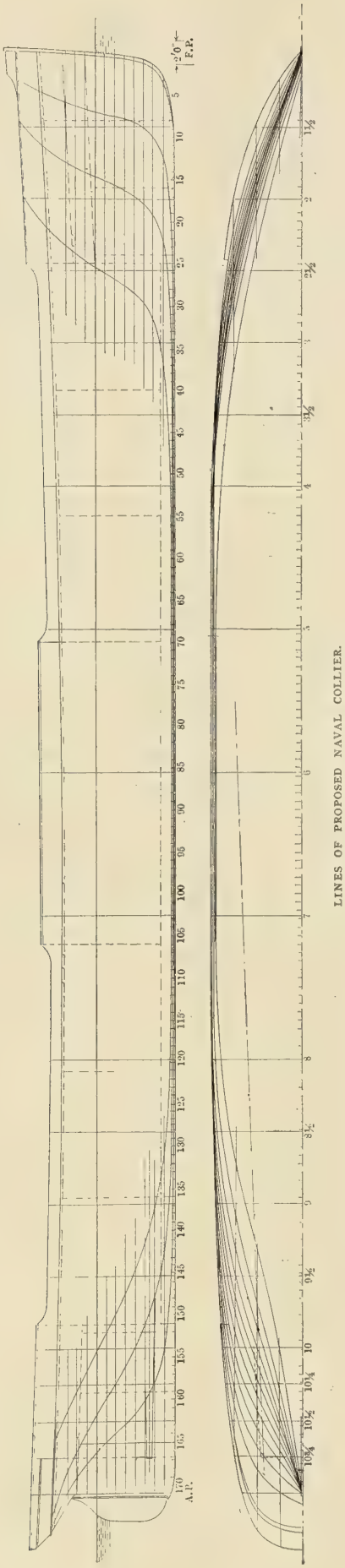
As there is ample room for any naval vessel to coal and use



CROSS SECTIONS OF PROPOSED NAVAL COLLIER SHOWING SCANTLINGS.


Wireless
Stay each side
Cableway each side
Capacity of 3 For'd Holds 5800 Tons at 47 Cu. Ft.
Capacity of 3 After Holds 4435 Tons at 47 Cu. Ft.
Engine Room
Bridge
MAIN DECK
Crews Mess Room
Shaft Drive for Winches
Shaft Drive for Winches and Windlass
Booms Lay in Chocks on Deck when Stowed
HOLD
Bunker
Oil Tanks
Cofferdam

INBOARD PROFILE, DECK AND HOLD PLANS OF PROPOSED NAVAL COLLIER.

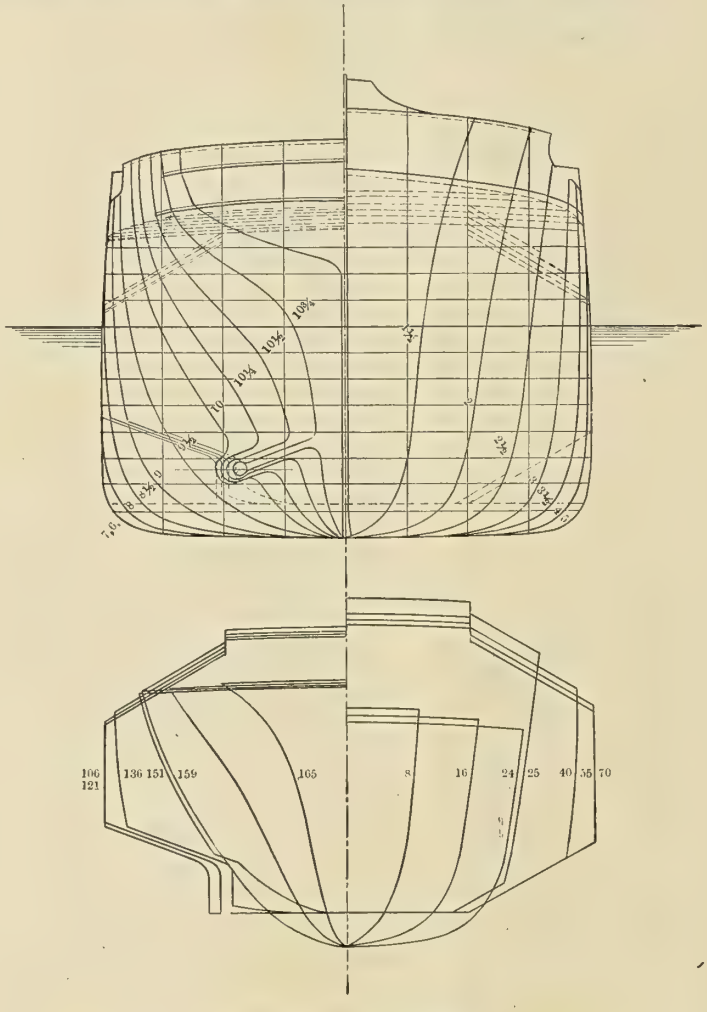


LINES OF PROPOSED NAVAL COLLIER.

all her gear either forward or aft two vessels can coal without the possibility of interference or necessity of hauling.

The arrangement of cable ways at the ends of cross trees will enable coal to be transported fore or aft to a Spencer Miller or other device for sea coaling. The cableway would be supported at each mast as in a land installation, thus avoiding the excessive sag and sway of a long span. The line of the cableway is well clear of the funnel, etc., while well within the hatches.

The lines of propeller shafting or of thrust extended forward have a long leverage about the pivoting point of the ship, thus giving the vessel great maneuvering power. Also this



BODY PLAN AND BULKHEADS.

direction of shafting will cause the propellers to cut the stream lines more nearly normally, thus increasing efficiency. As the propellers are well under the deck line there will be little danger of damage in hauling around coal piers.

It will be noticed that the vessel is club-footed aft as well as forward. This gives displacement, rigidity and accessibility with no essential disadvantages. The spread of spectacle framing is thereby reduced.

The spectacle framing is approximately in the plane of the stream lines, not horizontal, as fitted a few years ago.

Oil tanks are fitted fore and aft, which are clear of cargo or coal, and there will be no dangerous mixture of the two to be cleaned out, as would be the case if the commodities alternated in same holds on successive voyages. The oil carried will be at the expense of the coal capacity, as the vessel can load to her marks with coal alone and have a 5 percent margin in holds to spare. A body plan of bulkheads is shown which is very useful in checking hold capacities and weights.

The lines of deck shafting with the friction-driven winches allow the use of large compound hoisting engines in suitable engine rooms, where they may be kept clean and protected and the elimination of long leads of deck steam piping, with their consequent condensation of steam. Driving the windlass and oil pumps by the same method helps along these lines. The steering engine and towing machine being in the bridge house and adjacent to the engine-room make for further economy and ease of maintenance.

All cargo booms step on the deck at the side of the hatches, and when stowed alongside the hatches will be entirely out of the way when using the cableway for sea coaling. The stowed position also offers a minimum of windage. All lifts and falls will be flexible wire, and may be left aloft at all times. The only manila will be the tackles on boom guys and signal halyards.

The hatches are steel in one piece and hinged. fastened down with screw clamps and require no tarpaulins. Small manholes in the main deck with ladders on the bulkheads at the ends of each hold will be fitted as escapes or for access.

For self-trimming purposes and for top ballast to reduce metacentric height when light, tanks are fitted under the deck at the side. Access to these will be through manholes well clear of the stringer plates.

There are no stanchions in the holds, but the hatch coamings are continuous, and with the sloping face of the tanks form a rigid support to the decks between bulkheads.

Pump rooms having no openings into quarters permit oil to be handled with little danger of explosive gases finding their way into the living spaces. The pumps are geared and of the deep-well type.

The quarters are so arranged that the captain is on a deck by himself, the other commissioned officers are on the starboard side of the bridge deck and the warrant officers on the port side. As there is a passage on the deck below there is no necessity for traffic of crew by doors of officers' quarters. Besides the dining rooms for officers a general mess room is provided for the crew with fixed tables and revolving stools. This will make for cleanliness and greatly facilitate work of the mess boys and stewards. Ample berthing space, with fixed pipe berths, lavatories, showers and water closets is provided forward for the deck and commissary force and aft for the engine force. The forecastle head and poop are planked and fitted with awnings. Toilet accommodations are provided adjacent to the engine room and boiler room exits for those coming off watch.

The bridge is near the pivoting point of the ship and has office quarters adjacent.

The main engines, to suit the location, have the air, bilge and feed pumps on the inboard side abreast the low-pressure cylinder housing, and are driven by the usual levers from the crosshead. The starting and reversing gear are abreast the intermediate housings, as usual. The condensers are independent of the engine framing, and are fixed on either after engine-room bulkhead, well above the air pumps. The auxiliary machinery is located under the hanging bunker amidships. The main engines are intended to develop 7,000 indicated horsepower, and drive the ship at 14 knots. The cylinders are 27, 44 and 76 inches diameter by 54 inches stroke. The propellers are four-bladed bronze, out turning, 16 feet 9 inches diameter.

Two double and two single-ended Scotch boilers are fitted for steam at 210 pounds pressure. This arrangement allows the power plant to be operated as two units, reducing water-tending troubles with feed pumps driven off the cross heads. Ellis & Eaves' induced draft with air heaters would be fitted, also ash ejectors with clinker crushers. It will be noticed that the coal bunkers load in the same manner as the general cargo holds by large central hatches, and they will require very little trimming.

The dimensions of the hull are 512 feet between perpendiculars by 64 feet beam and 39 feet depth, with 27 feet 6 inches draft. Displacement, 19,200 tons; prismatic coefficient, .7575; 'midship coefficient, .985; block coefficient, .7475.

TABLE OF WEIGHTS.

	Tons.
Hull, including forecastle, bridge, house and poop	4,000
Houses, bridges, casings, etc	250
Carpenter and joiner work	120
Paint, cement, etc	180
Total hull weights	4,550
Steering gear	15
Ventilation, pumping and drainage	92
Anchor and cable-handling appliances	35
Boat and coal-handling and warping and towing gear	115
Masts and spars	75
Miscellaneous allowance, including hand rails, air ports, doors and small hatch covers, etc	48
Total hull fittings	380
Steam engineering weights	1,220
Reserve feed water	100
Equipment, including anchors, chain, power plant, etc	160
Outfit and stores, including ladders, boats, furniture, cooperage and blocks and ship's complement	180
Margin	110
Total displacement without bunker or cargo coal	6,700
Bunker coal	2,000
Cargo	10,500
Total	19,200

MODERN TORPEDO BOAT DESTROYERS.

In general, as in battleship design, the tendency in torpedo boat destroyers is in the direction of higher speeds and larger displacements. While the early torpedo boat was intended for intermittent attack with a very limited cruising radius, the present day destroyer is a ship possessed of sea-going qualities, and by virtue of its speed has both defensive and offensive powers.

Features which characterize the new type of destroyers are found principally to be due to engineering innovations involving the machinery for motive power and the boilers for the generation of steam. While the earlier torpedo boats generally had only one screw, driven by reciprocating engines and locomotive boilers, and a speed of 22 to 23 knots, we find the present-day destroyer, fitted with two, three and even four screws on as many shafts driven by steam turbines with water-tube boilers fitted for oil burning and speeds from 30 to 33 knots. In fact, one may readily admit that to the introduction of these engineering features the high-speed destroyer owes its existence.

The armament in early torpedo boats consisted of two deck tubes, generally one bow tube and some 3-pounders. Present-day destroyers have three torpedo tubes, four on some Japanese boats, 3-inch and 4-inch guns, together with smaller arms. The bow tube is now dispensed with.

A very considerable advantage both in operation and for the purpose of further increasing the cruising radius, as well as to render a much longer run at full speed possible without cleaning fires (in fact as long as the fuel lasts), has resulted from the use of oil fuel instead of coal. While it is true that the partial protection afforded by the side coal bunkers is practically forfeited the best tacticians do not consider that this feature involves serious disadvantages. Were it possible to

foresee a sufficiency of oil fuel supply, at economical prices, no doubt exists at all, but what this system would be almost universally introduced not only for warships but for all ships intended for high-class service. No nation is so fortunately situated, except possibly Russia, with regard to oil resources, as is the United States.

The foregoing features, taken together with further improvements to render the turbine highly economical at even low-cruising speeds, as for instance is now being contemplated by some of the first naval powers by the introduction of transmission drives, will render the modern destroyer a ship of a very perfect type mechanically.

That the destroyer of to-day is designed for the purpose of following the fleet is evidenced by construction such as to increase sea-going qualities as well as size, securing comfortable and habitable quarters for officers and crew. These features in a large degree seem to dominate in the building of destroyers of to-day; no protection to any part of either hull or machinery has as yet been resorted to.

England possesses to-day about 140 destroyers of from 250 to 600 tons displacement, with 3,500 to 9,500 horsepower, giving a speed ranging between 25½ to 30 knots; six of about 850 tons, with 33 knots speed and 14,000 horsepower; six of from 950 to 1,000 tons displacement of 33 knots and 15,500 horsepower, and one, the *Swift*, of 1,800 tons and 30,000 horsepower of about 35 knots. Besides the foregoing, contracts have been given recently for twenty others of 770 tons displacement, 14,000 horsepower and a speed of 27¾ knots. All of the latter have steam turbines and are fitted for burning oil.

Germany has completed and has under construction about 102 destroyers in size ranging between 300 and 680 tons with speeds as high as 30 knots. Those now under construction are 616 tons displacement, 10,500 horsepower and 30 knots speed, and are equipped with steam turbines of Parsons, Curtis, Zoelly and Melms Pfenninger type. The German torpedo boat destroyers are designated by letters and numbers in combination, as, for instance, S-138, the letter being the initial of the builders's name; thus S stands for Schichau, G for Germania, V for Vulcan, etc.

France owns about eighty ships of the destroyer type of various sizes. The earlier ones range in size from 300 to 425 tons, with from 26 to 30 knots speed, the later are from 700 to 750 tons with speeds up to 31½ knots. Some of the recent French destroyers have been fitted with types of machinery of widely differing nature. Thus the *Hussard, Spahi* and *Carabinier* have reciprocating engines, the *Chasseur* has Parsons turbines, the *Voltigeur* a reciprocating engine and two *Rateau* turbines and the *Tirailleur* has reciprocating engines and turbines of the De Laval type by Brequet. Boilers are either Normand, Du Temple or Guyot.

Japan has about 60 destroyers all told. In size they range between 300 and 425 tons displacement, with speeds between 26 and 31 knots. Some later additions are of 1,100 tons displacement and 33 knots speed.

The United States does not compare favorably as regards numbers with other first-naval powers. Up to date there are completed twenty-one destroyers, while fifteen are under construction and six others have been authorized by the enactment into law of the last naval appropriation bill. The table at the bottom of the page gives the particulars of destroyers completed and under construction for the United States navy.

HULL CONSTRUCTION.

The material used in torpedo boat destroyers must be, of necessity, the very best. High-tensile steel of about 75,000 pounds tensile strength is used in everything about the hull except for liners and hatch casings. The material for the rivets is also of the same high grade.

All steel material below the main deck sheer strakes is galvanized, including the outside shell plating, vertical center keel, longitudinals, frames and reverse bars, floor plates, bulkheads and stringers. The inside of the oil fuel tanks, when such are fitted, is, however, not galvanized, as liquid fuel in itself is a preservative for steel. The galvanizing is done by the hot method, and before each member is placed in position and riveted.

While the arrangement of compartments and decks differs for different service, the customary deck arrangements com-

TORPEDO BOAT DESTROYERS COMPLETED AND UNDER CONSTRUCTION FOR THE UNITED STATES NAVY.

Name of Ship.	By Whom Built.	Type of Engine.	Number and Type of Boiler.	Trial and Designed Displacement.	Estimated and Trial Horsepower.	Estimated and Trial Speed.
Bainbridge	The Neafy & Levy S. & E. B. Co.	Twin screw, reciprocating	4 Thornycroft, old type	452 trial	8,000 estimated	28.45 trial
Barry	The Neafy & Levy S. & E. B. Co.	Twin screw, reciprocating	4 Thornycroft, old type	462 trial	8,000 estimated	28.12 trial
Chauncey	The Neafy & Levy S. & E. B. Co.	Twin screw reciprocating	4 Thornycroft, old type	460 trial	8,000 estimated	28.64 trial
Dale	Wm. R. Trigg Co.	Twin screw, reciprocating	4 Thornycroft, old type	457 trial	8,000 estimated	28.00 trial
Decatur	Wm. R. Trigg Co.	Twin screw, reciprocating	4 Thornycroft, old type	450 trial	8,000 estimated	28.1 trial
Hopkins	Harland & Hollingsworth	Twin screw, reciprocating	4 Thornycroft, old type	467 trial	8,000 estimated	29.02 trial
Hull	Harland & Hollingsworth	Twin screw, reciprocating	4 Thornycroft, old type	440 trial	8,000 estimated	28.03 trial
Lawrence	Fore River Shipbuilding Co.	Twin screw, reciprocating	4 Fore River	412 trial	8,000 estimated	28.5 trial
Macdonnough	Fore River Shipbuilding Co.	Twin screw, reciprocating	4 Fore River	405 trial	8,000 estimated	28.03 trial
Paul Jones	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	8,000 estimated	28.91 trial
Perry	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	7,950 actual	28.32 trial
Preble	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	475 trial	7,370 actual	28.08 trial
Stewart	Gas Engine & Power Co.	Twin screw, reciprocating	4 Seabury	439 trial	8,000 estimated	29.7 trial
Truxton	Maryland Steel Co.	Twin screw, reciprocating	4 Thornycroft, old type	486 trial	8,300 actual	29.58 trial
Whipple	Maryland Steel Co.	Twin screw, reciprocating	4 Thornycroft, old type	481 trial	8,300 actual	28.24 trial
Worden	Maryland Steel Co.	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	8,300 actual	29.86 trial
Lamson	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 Mosher	700 designed	10,000 estimated	28.00 estimated
Smith	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 Mosher	716 designed	10,362 estimated	28.35 trial
Mayrant O	Wm. Cramp & Sons	Twin screw, Zoelly turbines	4 White-Forster	700 designed	13,000 designed	29.5 estimated
Warrington O	Wm. Cramp & Sons	Twin screw, Zoelly turbines	4 White-Forster	700 designed	13,000 designed	29.5 estimated
Patterson O	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 White-Forster	700 designed	12,000 designed	29.5 estimated
Ammen C	N. Y. Shipbuilding Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
McCall O	N. Y. Shipbuilding Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
Burrows O	N. Y. Shipbuilding Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
Preston	N. Y. Shipbuilding Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	719 trial	10,918 actual	29.17 trial
Walke O	Fore River Shipbuilding Co.	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Sterret O	Fore River Shipbuilding Co.	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Perkins O	Fore River Shipbuilding Co.	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Reid	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	690 trial	12,421 trial	31.82 trial
Flusser	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	686 trial	11,541 trial	30.41 trial
Paulding O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Drayton O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Trippe O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Monaghan O	Newport N. S. & D. D. Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated
Roe O	Newport N. S. & D. D. Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated
Terry O	Newport N. S. & D. D. Co.	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated

NOTE.—O = Oil fuel.

prise main deck, berth deck and forecastle deck. The berth deck is flat, while the main deck is built with a crown, amounting to ½ inch per foot of beam. The forecastle is constructed with the usual flare forward. The principal compartments, such as the engine and boiler rooms, coal bunkers or oil fuel tanks, are below the main deck. Living quarters for the officers are placed either forward or aft, being arranged forward under the forecastle in the latest American destroyers. The quarters consist of the wardroom, the commanding officer's stateroom, chief petty officers and petty officers' rooms, officers' lavatory and water closets, crew's quarters and wash rooms and water closets, galley, pantries and store rooms.

Compartments and tanks are provided with air ducts for ventilation, the water-tight and oil-tight work having to pass well-defined tests both under water and air pressure.

Forward under the forecastle deck are the lamp room, paint and oil room and windlass engine space. Under the main deck are provided hold, torpedo warhead room, handling rooms and magazines. On top of the forecastle deck is the pilot house. The wireless telegraph operating room is located convenient to the pilot house. Besides the foregoing compartments there are chain lockers, trimming tanks, reserve feed-water tanks and fresh-water tanks. On the man deck are placed the ship boats, usually two whale boats and a dory, torpedo tubes, guns, the blower vent tubes and the smoke pipes.

The deck machinery consists of windlass, anchor, boat and torpedo cranes, a steam steering engine located in the pilot house. There is usually also a hand-steering apparatus aft on the main deck. Complete sets of draft gages with outside connections and glass tubes are fitted within the ship.

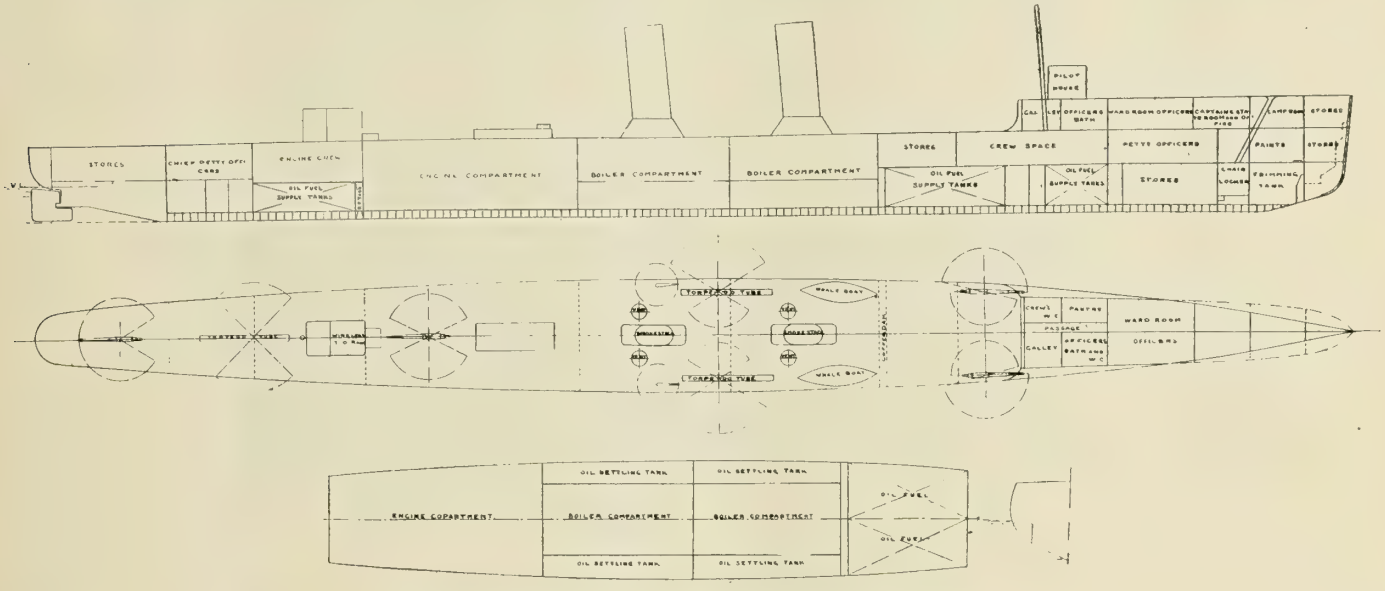
ELECTRIC LIGHT PLANT.

This consists of one or two generating sets (of about 5-kilowatt capacity each, 125 volts at the terminals). There is one (1 kilowatt) motor generator for the wireless outfit, a set of ship's running lights (combined oil and electric) and a number of electric fans of 1/12 horsepower each. The telephone service consists of two independent systems. The generating sets are operated with a normal pressure of 200 pounds per square inch gage and 25 inches vacuum. The generator is direct-current compound wound. The switchboard is placed in the engine room for the control of the electric installation, with ammeters and voltmeters, lamp ground detector and field regulator.

PUMPING, DRAINAGE AND FLOODING SYSTEMS.

In general these include the fire system, sanitary system, fresh-water system, drainage and flooding systems. The sanitary system connects with the fire main and supplies the water closets, wash rooms and galley. The fresh-water system consists of fresh-water tanks having direct connection to the distiller fresh-water pump. A hand pump suction leads from this tank with a discharge to the gravity tank, which is placed high up in the ship, supplying the galley and the drinking faucets. The fire system consists of a continuous pipe about 3 inches diameter leading under the deck beams of the engine and boiler rooms, connecting with the fire and bilge pumps in the ship, with risers along its length at suitable places.

The drainage of the engine and boiler rooms is done by direct connections to bilge pumps. Other compartments are drained either by permanent connections to the bilge pump manifold or by using temporary hose connections. The fore and after peaks have sluice valves, and drain into adjoining compartments. All tanks, cofferdams and compartments intended for trimming purposes are supplied with the usual arrangement of sounding pipes and air escape tubes. All holds, water closets, magazines, tanks and other closed compartments are ventilated by properly arranged vent pipes, ducts or hatches. The engine and boiler rooms are drained by direct connections to the fire and bilge pumps placed in said compartments, and the suction ends of the piping enclosed in strainers draw from the lowest available space. Pipes and pockets in any part of the machinery where condensed steam may accumulate are provided with drains, discharging through traps either to the feed tank or condensers. Drains from the turbines have no traps, but lead direct to either the main condensers, bilge or the turbine exhaust. In cases of emergency the magazines and warhead rooms may be flooded through specially fitted flood pipes. The trimming tanks, both forward and aft, may be flooded by connections to the fire main.



GENERAL ARRANGEMENT OF A MODERN TORPEDO BOAT DESTROYER.

HEATING PLANT.

The steam heating system is worked under a pressure of about 50 pounds gage, and is arranged in independent circuits with steam connection from the main or auxiliary steam line. About 1 square foot of heating surface is provided for each 125 cubic feet of space to be heated. The drain from the discharge coils connects, by means of a trap, to the feed tank.

REFRIGERATING PLANT.

Ice-making machinery is not usually provided in destroyers, but built-in ice chests and refrigerators are furnished separately in the spaces allotted for officers and crews.

COMPRESSED AIR SYSTEMS.

An air compressor and accumulator for charging torpedoes is placed in the engine room. It connects with the pneumatic main, which runs through the machinery space. The purposes served are for the running of pneumatic tools, blowing soot from the boiler tubes and for operating the oil-fuel service pumps while getting up steam. The air pipes and accumulators are tested to a pressure of 3,000 pounds per square inch by charging with the air compressor running.

EVAPORATING AND DISTILLING PLANT.

The number and size of evaporators and distillers are determined by the quantity of water required, and are figured on a basis of .6 square foot of heating surface for each gallon of water to be evaporated and about .4 square foot of cooling surface for each gallon of water to be distilled per hour. Steam to evaporators is taken from the auxiliary steam pipe and the feed from the distiller circulating water discharge. In the latest American destroyers the evaporators are required to evaporate 3,000 gallons of water per twenty-four hours and the distillers 1,000 gallons for the same time.

FUEL-OIL SUPPLY AND SERVICE SYSTEM.

In ships fitted for burning oil, fuel-oil storage tanks are placed below the main deck, one or more forward of the boiler room, from which they are separated by a cofferdam, and another aft of the engine room. They are divided into compartments by flats and bulkheads, each with an independent suction surrounded by a steam coil and strainer. The suction connects to a valve whose steam is acted upon by a float in the tank, which shuts the valve when the tank is filled to the proper level. Amidships and abreast of the boilers are located, low down, the settling tanks, divided into separate tanks by the boiler room bulkheads. Those on the port side are connected to the starboard tanks by means of cross connecting pipes, thus obviating independent suctions, the latter being arranged for only on one side of the ship. The settling tanks have gage glasses showing the oil level. The storage tanks are arranged with air escape pipes, sounding pipes and steaming-out connections. There is one fuel-oil supply pump for each boiler room, together with service pumps in duplicate. The suction piping to the oil supply pumps is arranged so that either pump may draw from any storage tank and to discharge to either settling tank. The steam connection to these pumps is controlled by a chronometer valve, which, by a system of links and floats in the settling tanks, closes the steam connection to the pump when the settling tanks are filled to the working level. The steam to the heating coils is taken from the auxiliary steam line. All suction and discharge pipes are made of large diameters so as to admit of low oil velocities.

MACHINERY INSTALLATION.

The destroyers now building, as well as those constructed within the last four or five years, both for the British and American navies, are generally equipped with steam turbines for the propelling machinery in one single compartment. Those of British design all have Parsons except three, contracted for by Messrs. Brown & Company, of Glasgow, which will have Curtis. In the United States navy fifteen destroyers have Persons, three Curtis and two Zoelly turbines. The latter two types have not yet been tried. With Parsons turbines three shafts are commonly used, with Curtis and Zoelly two shafts. The steam pressure at the turbine valve chest with Parsons turbines is about 220 pounds gage and 250 pounds gage with Curtis and Zoelly. No superheat is used in either. The average revolutions per minute with the former at full speed are about 800, while from 600 to 650 is estimated for the latter. Separate cruising turbines are usually installed with Parsons arrangements, and when maneuvering only the low-pressure turbines are used, which also contain the astern units. The operating platform is arranged forward with stop and operating valves located on the forward engine-room bulkhead.

The condensing apparatus consists of two condensers, two ordinary air pumps and a large circulating pump for each condenser. Modifications to this arrangement will be found in some destroyers where augmentors are fitted to increase the vacuum, and in lieu of independent circulating pumps scoop injection with a small auxiliary circulator on each condenser injection pipe. In the case of the *Voltigeur,* a French destroyer, fitted with a reciprocating engine and two turbines, there are three condensers, one for the engine and one for each turbine.

The condensers have either straight tubes, the ends having packings screwed up with ferrules, or are bent, together with the body of the condenser, to a certain radius with the tube ends expanded in the tube sheets. This latter system has the advantage of lightness.

The feed system is sometimes arranged with main feed pumps in the engine room, while the auxiliary feed pumps are placed in the fire room, or with one main and auxiliary feed pump placed in each fire room, both systems having their advocates. The pumps draw from the feed tank, and also have a suction connection from the channel way and discharge through the feed heaters into the boilers. All feed pipes are copper. The main steam pipes are run in independent circuits, with cross connections, connecting two boilers each to stop valves on the forward engine-room bulkhead. Connections are here made to the turbines through the steam strainer. Expansion joints, or large bends, are provided at all necessary places in order to counteract the effects of expansion taking place in the rather heavy and inflexible steel pipes now universally used.

Auxiliary steam piping supplies all the auxiliary machinery, and connection is made direct to it from the main line.

The lubricating system, both for main and auxiliary machinery, among the latter especially for the blowers, is of great importance. The main turbines always have an independent system consisting of two separate oil pumps, one or two oil coolers with circulating pump, oil drainage tank and temperature-reading station. The air cooler is either of the surface condenser type or the film type. In the former the water circulates four times between the tubes, between inlet and outlet, in opposite direction to the oil, which goes through the tubes. In the film type the oil is forced to take a circular motion, due to the spiral shape given the pipes, the water circulating twice over the oil in any one circuit. The cooler is placed high up, forming a gravity tank, whence the oil issues direct into the supply pipe system. Having passed all the oiling stations (bearings) the oil returns through the oil drainage system back to the oil drain tank, which is placed as low down in the ship as possible. The oil pressure in the discharge pipe is about 10 pounds. Each oil discharge pipe leading to the respective bearings is furnished with cock and coupling for disconnecting and overhauling. Sight glasses are provided to observe the flow, and thermometers to ascertain the temperature. A strainer is placed in the pump suction chest. The pipes are made of copper and are of large sizes.

BOILERS.

The type of watertube boiler used in destroyer installations is the so-called "small diameter tube" type, which is generally taken to mean a boiler having generating tubes less than 1½ inches in diameter. Among this type we find boilers known under the following names: Yarrow, Thornycroft, Schultz,

Normand, White-Forster, Mosher, Du Temple, Guyot, Schichau, and probably some others of more or less worth.

There are usually two boiler compartments with two boilers in each compartment. The number of smokestacks varies, and is usually with the Normand boiler, one for each boiler. With other types either two or three smokestacks. Since fairly economical (40 to 50 pounds steam per horsepower) small-powered steam turbines have been placed on the market, their use seems favored for destroyer work by many builders to drive the blowers. Each blower, two for each boiler room, connects, through an independent vent on the main deck, with the outside.

When oil fuel is used the grate is dispensed with, but the boiler is otherwise designed and built in the same manner as for coal, except that firebrick takes the place of ashpans.

The oil fuel systems as used in American and British destroyers operate by mechanical atomization of the oil under high pressure (150 to 300 pounds per square inch), the necessary air for combustion being supplied by the forced-draft blowers.

There are installed as parts of an oil-burning system light service oil pumps for pumping oil from the oil fuel tanks to the settling tanks abreast of the boilers. Two fuel-oil pressure pumps, which draw from the settling tanks and discharge through the oil heaters, the oil being here heated to near flash point (200 to 230 degrees F.), to the burners in which the oil is mechanically atomized and mixed with air for combustion.

The revolutions of turbine blowers are from 1,000 to 1,500, and the air pressure in the fire rooms ranges between 3 and 5 inches of water. The boiler pressures run as high as 265 pounds gage. The evaporation per square foot of heating surface in good boilers may be as high as 12½ pounds of water per square foot of heating surface from and at 212 degrees F. and 13½ pounds per pound of fuel.

SHAFTING AND PROPELLERS.

The shafting is made of high-grade steel with a tensile strength of about 80,000 pounds per square inch and is made hollow. The bearings are water-cooled and have forced lubrication.

Propellers are made of manganese bronze or Monel metal, with weights balanced and with blade surfaces planed or otherwise finished.

ECONOMY RESULTS.

At full speed the steam consumption per horsepower-hour in destroyers with steam turbines is superior to that obtained with reciprocating engines, the reverse being the case at reduced speeds. Under the former conditions 14 pounds steam per shaft-horsepower is a good, average result. or from 1.5 to 1.6 pounds of coal per shaft-horsepower developed, giving an average of 3.6 knots run per ton of coal. At one-tenth power the corresponding figures are about 23 pounds of steam per shaft horsepower hour, 28 pounds coal and 10.8 knots run per ton of coal.

FIG. 1.—NEW STEAMSHIP ALABAMA OF THE GOODRICH TRANSIT COMPANY.

IMPROVEMENTS IN THE WELIN QUADRANT DAVIT.

About three weeks ago the new steamship *Alabama,* of the Goodrich Transit Co., was put into commission, and is now in regular service on the Great Lakes. This new steamer will be fully described in a future issue, but in this article it is our intention to bring to the notice of our readers her equipment for safeguarding the lives of her passengers. The *Alabama* carries twelve metallic lifeboats, of the standard Lane & De Groot type; these are equipped with Mills releasing gear, and are operated under twelve sets of Welin quadrant davits. The accompanying illustrations show the simplicity of these davits and the compact mechanism. It is doubtful whether so many boats could have been placed in such a relatively small space without the use of this device, and yet considerably more longitudinal space might have been saved by the use of double frames between boats; however, the designers of the *Alabama* doubtless had reasons for not taking advantage of the double-frame arrangement.

The davits on the *Alabama* are of the regular Welin type, with the addition of lowering drums, which are plainly shown in Figs. 2 and 3. As can be seen, each fall is rolled on a drum, and the two drums required for each boat are keyed to one shaft and controlled by a friction band, which enables one man to lower both ends of the boat simultaneously. When hoisting the boats the falls can be rolled up independently—one drum at a time, if desired—to suit conditions. Ordinary manila falls can be used with these drums, but it is preferable to have them

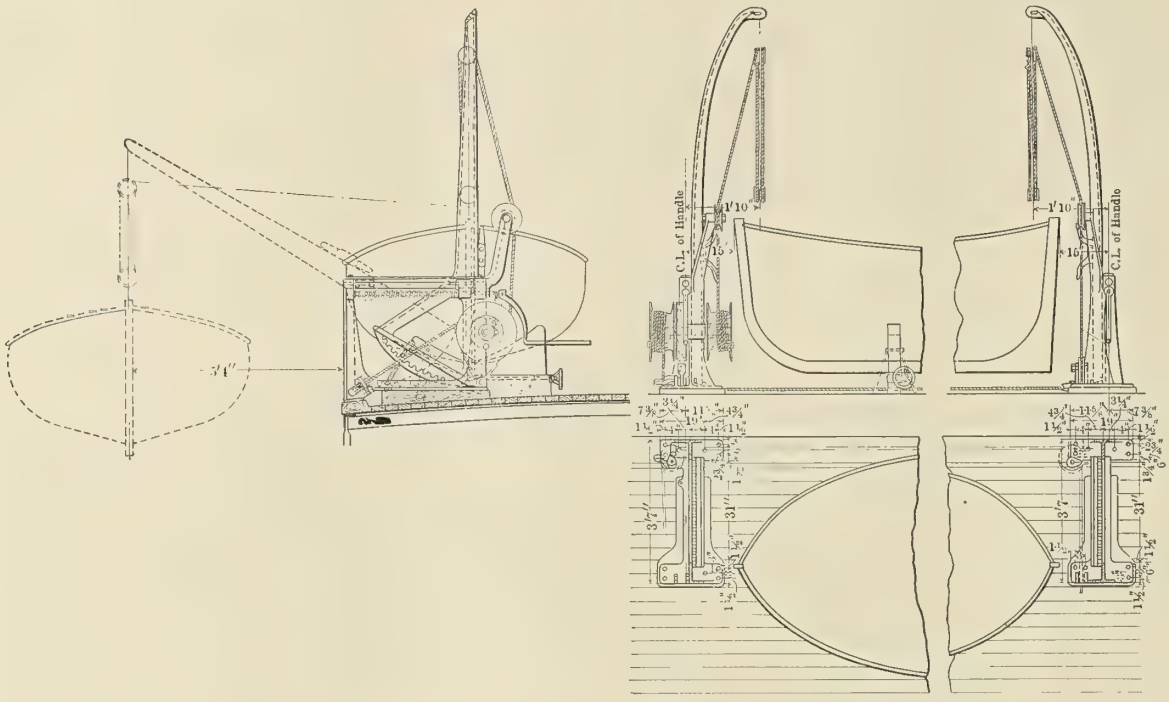


FIG 2.—WELIN QUADRANT DAVIT, WITH LOWERING DEVICE, SHOWING ARRANGEMENT OF DRUMS AND LEAD OF FALLS.

of durable wire rope, for the reason that they will not require as large a drum.

For some time past the question has been agitated of having —even with the most up-to-date boat-launching apparatus— some means for lowering both ends of a lifeboat simultaneously, by a mechanical device, and for this reason numerous patent applications have been made and patents issued with a view to covering this particular object. Comparatively few of the devices patented have real practical value, however, and the Goodrich Transit Company has apparently chosen the simplest and most efficient way of accomplishing the desired result, particularly when used in connection with tried and well-known apparatus like the Welin quadrant davits.

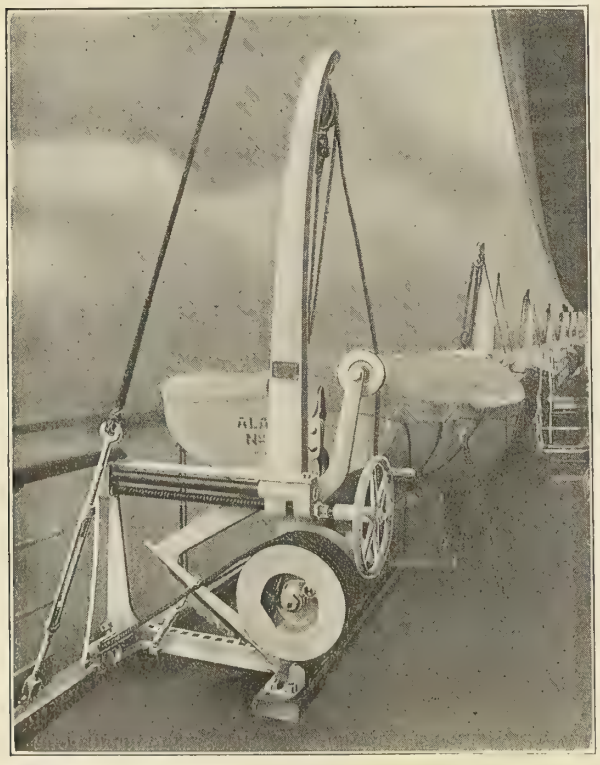


FIG. 3.—VIEW SHOWING BOAT-LOWERING DEVICE ATTACHED TO WELIN QUADRANT DAVIT ON SS. ALABAMA.

It is interesting to note that the *Alabama* is the first vessel on the Great Lakes to be entirely fitted out with these modern davits, as heretofore they have been applied principally on ocean-going passenger ships, where danger seems more imminent, and on such vessels as harbor tugs, revenue cutters, cable ships, etc., where it is imperative to be able to lower a boat quickly and under all conditions for working purposes. From the large list of marine disasters on the Great Lakes, however, it is evident that the need for modern life-saving appliances is just as great there as on the ocean, and therefore any movement to use every precaution for preventing loss of life is much to be commended.

The *Alabama* is also equipped with a modern type of life preserver. She carries 2,000 of the so-called A-B-C belts, which are made of a very light tropical wood instead of cork. This material, it is claimed, cannot crumble and deteriorate as does the latter, and the impervious composition with which the wood is covered keeps it always buoyant, no matter how damp the atmosphere. Furthermore, a vessel can carry one-third again as many of the A-B-C belts in the same stowage space as for ordinary belts, because they are one-third lighter and smaller than the ordinary belts.

Among the latest installations of Welin quadrant davits ordered in Europe are the equipments for the *Titanic* and *Olympic*, the gigantic White Star liners now building. These vessels will be fitted with the double-acting quadrant davits. Each vessel will carry sixteen sets of these davits, and this provides for the handling of thirty-two lifeboats, each over 30 feet long, as with this style of davit two boats can be carried under each set. The advantages of this modification in the Welin davits, *i. e.*, the double quadrant, is so apparent that it scarcely requires comment. On the basis of this design

the British Board of Trade made a new ruling regarding the carrying of two boats under one set of davits, and when so conservative a body as the British Board of Trade takes such action in a matter of this kind there is no doubt but that other nations will soon follow their lead, especially as the advantages of the concession are undoubtedly great. In the first place more lifeboats can be carried on a ship; second, the cost of installation is reduced, and, third, the reduction in weight is considerable, amounting to something like 30 percent. Then there is the possibility of improving the whole deck arrangement by clearing the more valuable sections of the deck and shifting the boats elsewhere, where free space is of less importance. We think it is safe to predict that there will be a little revolution in davit equipment on some of the older ocean passenger steamers as soon as the new White Star boats are in commission, or even sooner, as many lines abroad are already considering alterations in their boat decks on certain of their old ships, with a view to gaining promenade space. In such cases the concession by the British Board of Trade, above referred to, naturally proves of immense assistance.

It has often been asked whether the Welin quadrant davits have actually been the means of saving lives, and in this connection the following story may be of interest: The *Star of Japan* was wrecked on the West Coast of Africa some time ago. Two of her lifeboats were provided with Welin davits, and the two remaining ones were slung from the ordinary type. In the captain's report of the catastrophe it was made quite clear that not only had the latter proved useless under the adverse circumstances prevailing at the time, but also that the saving of every soul on board was due to the efficiency of the Welin davits. The owner of the vessel, the late Mr. Corry, of London, emphatically asserted that henceforth no other type of davit should be fitted to his ships. The next order received by the Welin people was only for three sets, however, while it was known that the ship would carry four boats, and upon inquiring into the cause for this discrepancy, the Welin Company's representative learned that one set had been fished out from the wreck, brought home, and would now be refitted to the new steamer—the *Star of Canada.* The Welin Company is arranging to fit a suitable memorial plate to that particular set of davits.

Here is an instance, therefore, where the Welin davits have saved the lives of an entire ship's crew, and when we consider the innumerable marine disasters and the thousands of lives lost owing to "inability to launch the boats on one side of the ship," or, in other words, inefficiency of the boat-launching devices, the moral obligation of vessel owners to provide for the safety of their passengers and crews is clearly pointed out.

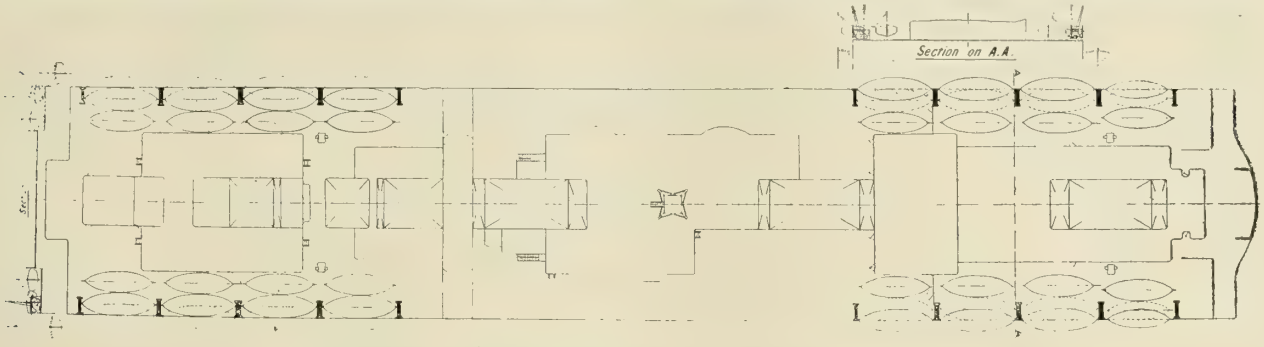


FIG. 4.—ARRANGEMENT OF BOATS ON NEW WHITE STAR LINERS OLYMPIC AND TITANIC.

Lloyd's Register Shipbuilding Returns.

From the returns compiled by *Lloyd's Register of Shipping* it appears that, excluding warships, there were 394 vessels of 1,118,587 tons gross under construction in the United Kingdom at the close of the quarter ended June 30, 1910. The tonnage now under construction is about 61,000 tons more than that which was in hand at the end of last quarter, and exceeds by nearly 373,000 tons the total building twelve months ago. The figures of the warship tonnage now being built (378,523 tons displacement) are the largest reported since June, 1901.

Rulings of the Office of the Supervising Inspector-General of the United States Steamboat Inspection Service.

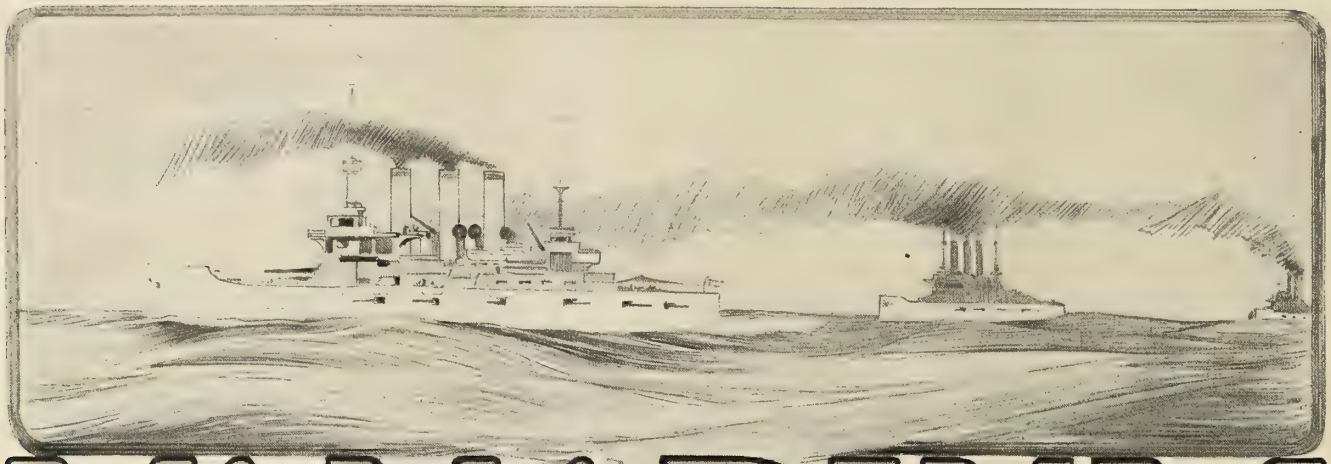
That part of section 19, rule 11, relating to reinforcing holes exceeding 6 inches in diameter cut in boilers for pipe connections, manhole and handhole plates, it has been held "that the reinforcing ring referred to must be of iron or steel plate, and the flange of a cast steel valve or fitting would not be a proper reinforcement for such holes under the rules and section referred to, except on boilers carrying 75 pounds or less steam, when the flange of a stop valve of sufficient thickness may be used as a reinforcement of such opening."

The matter of whether a steam dredge drawn to the shore by the use of a steam windlass on the dredge, said dredge having neither a propeller or water-wheel or a helm, is subject to the inspection of this service, this office has held that dredges such as described above are not subject to inspection.

It has been decided by the United States Navy Department to convert the *Arethusa* into an oil-fuel ship, and this work is being done at the Norfolk navy yard. The vessel will carry about 4,000 tons of liquid fuel and will be of use in connection with the oil-burning torpedo boat destroyers now in service and others of that type destined shortly to be commissioned.

The Attorney-General of the United States has rendered an opinion concerning the effect of the clause in the naval appropriation act of June 24, applying the so-called eight-hour law of 1892 to the contracts for the construction of the one battleship and two fleet colliers which are to be built by contract, to the effect that "the provision must be construed to apply simply to work done upon the vessel itself at the place where it is built, and not as applying to the manufacture of machinery of other material elsewhere which is to enter into the construction of the vessel."

Robert H. Laverie was appointed by the administration of the Bureau Veritas as chief surveyor for the United States, beginning his services June 1, 1910. Mr. Laverie's headquarters are at that society's New York offices, 17 State street, where he is prepared to render any services required in his capacity as naval architect and marine engineer, either in connection with classification or private surveys of any description.



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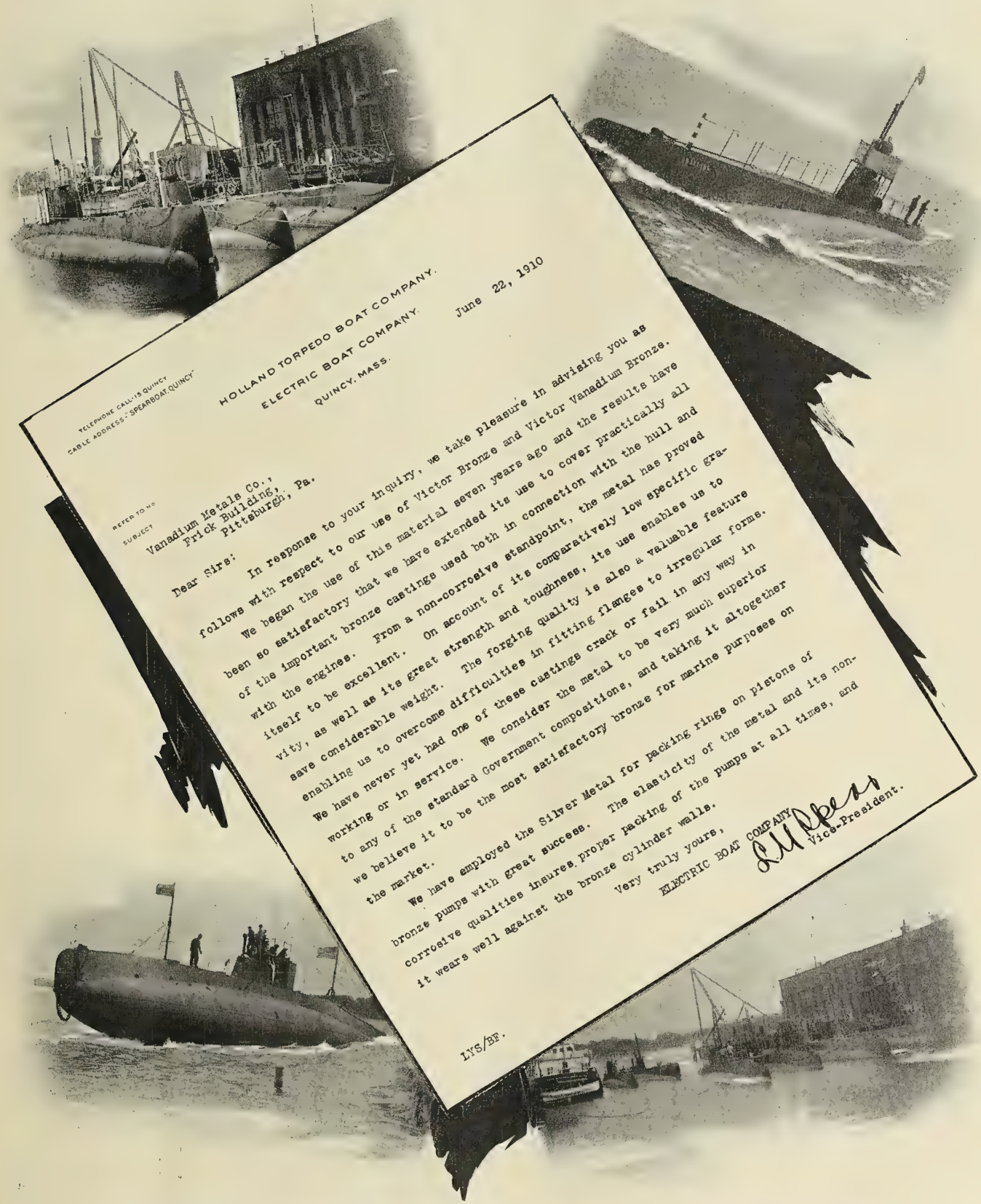
A TESTIMONIAL



HOLLAND TORPEDO BOAT COMPANY.
ELECTRIC BOAT COMPANY.
QUINCY, MASS.

June 22, 1910

TELEPHONE CALL IS QUINCY
CABLE ADDRESS: SPEARBOAT QUINCY

REFER TO NO
SUBJECT

Vanadium Metals Co.,
Frick Building,
Pittsburgh, Pa.

Dear Sirs:

In response to your inquiry, we take pleasure in advising you as follows with respect to our use of Victor Bronze and Victor Vanadium Bronze.

We began the use of this material seven years ago and the results have been so satisfactory that we have extended its use to cover practically all of the important bronze castings used both in connection with the hull and with the engines. From a non-corrosive standpoint, the metal has proved itself to be excellent. On account of its comparatively low specific gravity, as well as its great strength and toughness, its use enables us to save considerable weight. The forging quality is also a valuable feature enabling us to overcome difficulties in fitting flanges to irregular forms. We have never yet had one of these castings crack or fail in any way in working or in service. We consider the metal to be very much superior to any of the standard Government compositions, and taking it altogether we believe it to be the most satisfactory bronze for marine purposes on the market.

We have employed the Silver Metal for packing rings on pistons of bronze pumps with great success. The elasticity of the metal and its non-corrosive qualities insures proper packing of the pumps at all times, and it wears well against the bronze cylinder walls.

Very truly yours,
ELECTRIC BOAT COMPANY
Vice-President.

LWS/BF.

VANADIUM METALS COMPANY

FRICK BUILDING, PITTSBURGH, PA., U. S. A.

FOUNDRY, EAST BRAINTREE, MASS.

COMPARATIVE TRIALS OF AMERICAN SCOUT CRUISERS.*

The board appointed by the Navy Department to carry out comparative tests of the main and auxiliary machinery of the scout cruisers United States ships *Birmingham, Salem* and *Chester* has submitted a report, embracing an analysis of the results obtained, together with a copy of the data recorded during the various tests made.

The object of the tests was to ascertain and compare the steam economy of the three types of propelling machinery fitted in the vessels named, the hulls being practically of the same model, at various speeds while underway and under as nearly as possible identical conditions. In order to make the comparison complete six distinct series of tests were carried out, as follows:

I. Tests of auxiliary machinery (vessel in port).

II. Boiler evaporative tests (vessel in port).

III. Standardization runs. Each vessel was standardized over the Rockland measured mile course just prior to undertaking the (IV.) steam-consumption tests. As will appear later, this involved standardizing the *Salem* on two different occasions, as two series of steam-consumption tests were carried out. In these trials, moreover, and as well as all other (V. and VI.) sea runs, the aim was to load each vessel so that the displacement for each trial should be as nearly as could be calculated in the beginning, an average of 4,000 tons. All ships were dry-docked prior to standardization and coal-consumption trials, and the bottoms cleaned and painted.

IV. Steam-consumption tests of main and auxiliary machinery (vessel under way).

V. Coal-consumption tests of about 1,000, 750 and 2,000 knots at speeds, respectively, of 10, 15 and 20 knots.

VI. A full power run of twenty-four hours' duration. The *Birmingham* was unable to complete this trial on account of a defect which developed in the machinery. This vessel, after finishing twelve hours of the test, slowed down and returned to port.

* Abstract of report of Board on Comparative Trials of the scout cruisers *Birmingham, Salem* and *Chester*, by Capt. F. H. Bailey, Commander Gustav Kaemmerling and Commander W. W. White.

PRINCIPAL HULL DATA.

The hulls of all vessels, except in minor particulars, are alike. Steel is used throughout, and the outside plating generally is on the raised and sunken strake system. The frames, spaced 36 inches apart, are generally of channel section, 6 by 2 13/16 by 2 13/16 by 13.3 pounds.

The outside plating, below the load waterline, consists of 15-pound plating, reduced to 12-pound at the ends, and of 12-pound plating elsewhere. Flat keel plates, about 36 inches in width, are in two thicknesses; the inner of 17½ and the outer of 20-pound plate. The vertical keel, about 39 inches in depth, is of 15-pound plate. Garboard and sheer strakes are 17½ pounds, reduced to 15 pounds at the ends. Nickel-steel

TABLE I.—SYNOPSIS OF HORSEPOWER, STEAM AND COAL CONSUMPTION.

Number of test.	Duration of test.	Name of ship.	Displacement.	Speed per hour in knots.[b]	Horsepower. Machinery necessary to propulsion. Main engines or turbines. I. H. P.	Main engines or turbines. S. H. P. = .94 × I. H. P.	Auxiliaries. I. H. P.	Total. I. H. P. (f+h).	Total. H. P. (g+h).	Steam. For all purposes per hour from curves of steam consumption tests.	Make up feed.[a] Tons per day.	Make up feed.[a] Pounds per hour.	Actual total on test in pounds (m+o).	Reduced to water evaporated from and at 212° per pound of coal. Actual on this test.	Reduced to water evaporated from and at 212° per pound of coal. As established by boiler evaporative tests.	Coal for all purposes per— Day. Cubic feet.	Day. Tons (43.5 cubic feet = 1 ton).	Hour. Pounds.	Hour. Pounds per hour per knot.	Hour. Pounds per square feet of grate surface.	Hour. Per I. H. P. of machinery necessary to propulsion.	Hour. Per H. P. of machinery necessary to propulsion.	Auxiliaries exhaust into—
a	b	c	d	e	f	g	h	k	l	m[c]	n	o	p	q	r	s	t	u	v	w	x	y	
1	Hrs 96	Birmingham	3,994.0	9.86	960	902.4	61.4	1,021.4	963.8	32,871	10.10	942.2	33,813	11.60	11.12	1,398	32.14	2,999	304	17.02	2.94	3.11	Second receiver, both engines.
		Salem	4,022.0	9.90	.....	668.4	115.1	.....	783.5	44,674	11.66	1,088.3	45,762	9.52	10.85	2,342	53.85	5,026	508	21.67	.....	6.41	E.R.auxiliary condenser, 40 minutes; main condenser, 29 hours 40 minutes; remainder third stage, forward turbine.
		Chester	4,026.9	10.03	.....	730.0	105.1	.....	835.1	36,097	10.97	1,023.8	37,121	9.54	9.64	1,830	42.06	3,926	391	16.92	.....	4.70	Port L. P. turbine.
2	50	Birmingham	4,001.9	15.00	3,263	3,067.2	89.2	3,352.2	3,156.4	67,438	13.90	1,297.3	68,735	10.87	11.20	3,098	71.21	6,646	443	14.32	1.98	2.105	Second receiver, both engines.
		Salem	3,964.5	14.91	.....	2,609.2	170.2	.....	2,779.2	84,280	12.12	1,131.2	85,411	9.06	10.86	4,665	107.23	10,008	671	21.56	.....	3.60	Third stage, forward main turbine.
		Chester	3,967.8	14.98	.....	3,201.3	128.1	.....	3,329.4	74,596	13.20	1,232.0	75,828	9.73	9.50	3,887	89.36	8,341	557	20.54	.....	2.51	Port L. P. turbine.
3	98	Birmingham	3,960.0	19.83	7,575	7,120.5	188.7	7,763.7	7,309.2	129,176	26.10	2,436.0	131,612	9.62	10.90	6,675	153.45	14,322	722	20.58	1.84	1.96	Second receiver, both engines.
		Salem	4,030.5	20.25	.....	6,883.3	329.0	.....	7,212.3	163,111	17.51	1,634.2	164,745	9.54	10.60	8,788	202.03	18,855	931	27.09	.....	2.61	Third stage, forward main turbine.
		Chester	3,970.3	19.90	.....	8,374.0	206.2	.....	8,580.2	134,270	16.80	1,568.0	135,838	9.55	9.44	7,086	162.90	15,205	760	21.84	.....	1.77	Starboard L. P. turbine.
4	12	Birmingham	4,059.0	24.00	14,828	13,938.4	535.9	15,363.9	14,474.3	271,545	120.4	11,237.3	282,782	8.42	9.52	16,344	375.72	35,070	1,461	50.38	2.28	2.42	Main condensers.
	24	Salem	4,028.0	24.32	.....	14,630.0	695.8	.....	15,325.8	293,103	45.63	4,258.3	297,361	8.36	9.25	18,060	415.15	38,749	1,593	55.74	.....	2.53	Main condenser, 30 minutes; remainder fourth stage, main turbines.
	24	Chester	3,961.6	25.08	.....	19,632.0	463.6	.....	20,095.6	314,161	27.00	2,520.0	316,681	8.70	8.03	18,679	429.40	40,078	1,598	57.42	.....	1.99	Starboard L. P turbine

[a] It is assumed that all the make-up feed was evaporated.
[b] Speed of each ship was taken from its standardization speed-revolution curve.
[c] Correction was made for the difference in the running of the auxiliaries of these tests and their corresponding steam consumption tests.

TABLE II.—SYNOPSIS OF HORSEPOWER NECESSARY TO PROPULSION.

Number of test.	Duration of test.	Name of ship.	Speed per hour in knots.	Number of turbines in use.	Steam pressure (gage). Engine room. Forward.	Steam pressure (gage). Engine room. After.	Steam pressure (gage). Steam chest main engines or initial turbine. Forward.	Steam pressure (gage). Steam chest main engines or initial turbine. After.	Vacuum (inches of mercury). Forward.	Vacuum (inches of mercury). After.	Revolutions (per minute).[a] Forward starboard.	Revolutions (per minute).[a] After port.	Revolutions (per minute).[a] Mean.	Horsepower. Machinery necessary to propulsion. Main engines or turbines S. H. P.[b] Forward starboard.	Main engines or turbines S. H. P.[b] After port.	Main engines or turbines S. H. P.[b] Both.	Auxiliaries I. H. P. Augmentor.	Wet vacuum pumps.	Dry vacuum pumps.	Main air pumps.	Main circulating pumps.	Main feed pumps.	Forced-draft blowers.	Oil pumps.	Total (t+u+v+w+x+y+z+aa).	Grand total (s+bb).
a	b	c	d	e	f	g	h	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa	bb	cc
	Hrs.																									
1	96	Birmingham..	9.86	...	210.0	209.0	50.0	48.7	25.0	27.2	73.02	73.03	73.02	451.2	451.2	902.4	.....	.....	.....	11.9	17.8	19.0	12.7	.....	61.4	963.8
		Salem..........	9.90	2	217.9	220.4	145.3	152.0	29.6	29.1	138.23	138.23	138.23	328.6	339.8	668.4	.....	19.2	37.5	.....	24.0	25.3	8.0	1.01	115.1	783.5
		Chester........	10.03	6	179.0	189.0	59.0	......	28.8	29.0	204.04	202.36	203.20	392.0	338.4	730.4	39.4	.....	.....	19.1	17.0	29.1	.....	.55	105.1	835.1
2	50	Birmingham..	15.00	...	214.0	214.0	98.0	103.0	25.6	26.8	111.88	111.95	111.91	1,495.5	1,571.7	3,067.2	.....	.....	.....	12.9	20.0	30.7	25.6	.....	89.2	3,156.4
		Salem..........	14.91	2	220.9	219.8	174.8	177.7	28.9	29.0	209.30	209.30	209.30	1,397.8	1,211.4	2,609.2	.....	19.5	38.2	.....	34.0	57.4	20.0	.92	170.0	2,779.2
		Chester........	14.98	6	197.0	202.0	159.0	......	28.3	28.9	313.60	310.47	284.43	1,621.3	1,580.0	3,201.3	40.6	.....	.....	14.0	32.4	40.5	.....	.61	128.1	3,329.4
3	98	Birmingham..	19.83	...	209.6	206.4	173.7	172.0	23.6	26.7	149.84	149.84	149.84	3,616.2	3,504.3	7,120.5	.....	.....	.....	16.0	31.0	62.0	79.7	.....	188.7	7,309.2
		Salem..........	20.25	2	220.6	220.6	189.1	181.0	28.3	28.6	282.27	282.27	282.27	3,423.6	3,459.7	6,883.3	.....	22.0	37.4	.....	92.8	72.2	103.5	1.08	329.0	7,212.3
		Chester........	19.90	5	172.0	176.0	147.0	......	28.0	28.9	407.02	432.68	419.85	3,470.0	4,904.0	8,374.0	37.8	.....	.....	26.1	60.5	75.0	6.0	.82	206.2	8,580.2
4	12	Birmingham..	24.00	...	250.0	238.0	229.0	226.0	25.0	26.3	189.90	189.10	189.50	7,380.0	6,558.4	13,938.4	.....	.....	.....	24.4	48.0	153.5	310.0	.....	535.9	14,474.3
	24	Salem..........	24.32	2	231.0	234.0	209.0	204.4	28.0	29.0	342.93	357.56	350.25	6,990.0	7,640.0	14,630.0	.....	33.2	37.2	.....	94.0	101.0	429.0	1.42	695.8	15,325.8
	24	Chester........	25.08	4	212.0	216.0	204.0	201.0	28.3	29.1	560.90	555.10	558.05	10,005.0	9,627.0	19,632.0	45.8	.....	.....	29.6	128.4	156.6	101.7	1.52	463.6	20,095.6

[a] As determined from counter readings at beginning and end of test.

[b] S. H. P. of Birmingham = .94 × I. H. P.

protection (80-pound plate) of variable width, extends fore and aft in wake of engine, boiler and dynamo rooms.

The weight of hull, including nickel-steel protection, but without machinery, coal, stores, outfit, armament and ammunition, etc., is approximately 2,015 tons. Principal dimensions are:

Length between perpendiculars, feet	420
Length over all, feet and inches	423—2
Length on L. W. L., feet	420
Breadth, molded, feet and inches	46—8
Breadth, extreme, feet and inches	47—0$\frac{3}{4}$
Ratio of length to beam	8.97
Draft (official contract trial, 3,750 tons displacement), feet and inches	16—9
4,000 tons displacement, feet and inches	17—4$\frac{1}{2}$
4,710 tons displacement (about fully loaded), feet and inches	19—2$\frac{3}{4}$
Displacement per inch at mean draft (16 feet 9 inches), tons	31.07
Area of midship section (3,750 tons displacement), square feet	566
Area of L. W. L. section (3,750 tons displacement), square feet	12,960
Wetted surface section (3,750 tons displacement), square feet	19,900
Coefficient (at 3,750 tons displacement):	
Block	.40
Midship	.72
L. W. L. plane	.66
Coal bunker capacity in tons (43 cubic feet per ton):	
Birmingham	1,395.3
Salem	1,388.3
Chester	1,407

MACHINERY INSTALLATIONS.

The machinery installations of these vessels have been described in previous issues, but the following recapitulation, as set forth in the report, may be of interest: The *Birmingham* and *Salem* are each equipped with twelve boilers of the Fore River type; heating surface, 37,992 square feet; grate area, 696 square feet; ratio, 54.5 to 1; steam pressure, 250 pounds. The *Chester* is equipped with Normand boilers; heating surface, 32,040 square feet; grate area, 696 square feet; ratio 46 to 1; steam pressure, 250 pounds. Details of the engines are as follows:

Birmingham.—The engines, which turn the propellers outboard, are of the vertical inverted four-cylinder, direct-acting, triple-expansion type, with unjacketed cylinders, placed in two watertight compartments, and operating twin screws. Each engine was designed for an indicated horsepower of 8,000 at 200 revolutions per minute, with a steamchest pressure of 250 pounds gage. Beginning forward, the order of the cylinders is, forward low-pressure, high-pressure, intermediate-pressure, and after low-pressure. The forward low-pressure and high-pressure cranks are opposite, as are the intermediate-pressure, and after low-pressure the second pair being at right angles with the first. All main valves are of the piston type, worked by double-bar Stevenson links. There is one piston valve for the high-pressure and two each for the intermediate-pressure and low-pressure cylinders.

Engine framing is of forged steel, cylindrical columns, trussed by forged-steel stays. All crank, thrust, line and propeller shafting is hollow, and shafts, piston and connecting rods and working parts, generally, are of forged steel.

CYLINDERS.

Number for each engine	4
H. P. diameter, inches	28$\frac{1}{4}$
I. P. diameter, inches	45
F. L. P. diameter, inches	62
A. L. P. diameter, inches	62
Diameter of piston rods, inches	6
Stroke of all pistons, inches	36

PROPELLERS (MANGANESE BRONZE).

Number of blades	3
Diameter, feet and inches	12—6
Pitch, (as set) mean, feet and inches	15—3
Pitch, adjustable, from feet and inches	14—6 to 16—6
Ratio of diameter to pitch	1.22
Area, projected, square feet	40.8
Area, helicoidal, square feet	49.4
Area, disk, square feet	122.7

There is one main condenser in each engine room, cylindrical in form, the important tube data being as follows:

CONDENSERS.

Number of tubes	4.085
Diameter (outside), inches	$\frac{5}{8}$
Thickness, B. W. G.	No. 16
Length between tube sheets, feet	12
Spacing (between centers), inches	15—16
Cooling surface, square feet	8,000

In the forward engine room there is an auxiliary condenser of 600 square feet cooling surface. There is also an auxiliary condenser for the dynamo plant, located in the dynamo room, having a cooling surface of 200 square feet.

FEED-WATER HEATERS.

There is a feed-water heater in each engine room, located on the discharge side of the main feed pumps, with 600 square feet of heating surface, composed of 679 $\frac{5}{8}$-inch tubes.

BOILERS.

It should be particularly noted that the products of combustion leave at the back of the furnaces, and on their way to the uptakes make a double passage across the tubes. In the *Chester's* boilers only a single pass is made by the gases of combustion, which enter the tubes near the front of the boiler furnaces.

FORCED-DRAFT BLOWERS.

The closed fire-room system is used, there being six independent Sturtevant fans installed, two to each boiler compartment, 66 inches in diameter, 24-inch width at tips of blades, of the double inlet type, with 42-inch intakes. Each fan is directly driven by a double-acting, two-cylinder, simple, horizontal engine (6 by 6), with cranks at 180 degrees, the steam admission and emission for both cylinders being controlled by one piston valve.

Salem.—The *Salem* is driven by outboard-turning twin screws, the propelling machinery, consisting of two Curtis marine reversible impulse turbines, one on each shaft, designed to develop 8,000 brake-horsepower, at 350 revolutions per minute with 250 pounds (gage) steamchest pressure. The machinery is arranged in two watertight compartments, separated by an athwartship bulkhead, the starboard screw being operated by the forward turbine.

Each turbine has a pitch diameter of rotating wheels of about 120 inches (center to center of buckets), and for the ahead motion consists of seven stages; each wheel is fitted with three rows of buckets, except in the first stage, which contains four rows. For backing there are two stages, the wheels or rotors being mounted on the shaft in the same casing as the go-ahead stages.

Each turbine consists of a cast iron cylindrical shell (for strength, cast steel is used in construction of the casing of the two first stages), divided by dished cast iron or cast steel diaphragms into separate compartments or stages. The moving buckets are mounted on the periphery of separate wheels in each stage, and all wheels are secured to and carried by a hollow steel shaft extending the length of the turbines. Where this shaft passes through the diaphragms, bronze bushings are provided, with small clearances, in order to prevent appreciable steam leakage from stage to stage, and where the shaft extends through the heads carbon-packed gland boxes are fitted to prevent steam leaking out at the ahead end, or air leaking in at the back end. These boxes are supplied with live steam between carbon packing, which makes an effective seal against air leaking in at the back end, and which, unless checked, would cause the vacuum to be lowered. Gland-box packing, on the ahead end, is required to withstand the pressure existing in the first stage only, in order to prevent steam leakage into the engine rooms; and, as this pressure is never excessive, under any condition of operation, no serious practical difficulty arises in guarding against such leakage. A drain, or "leak off," from these gland boxes leads to the fourth stage. The ahead steamchest contains twenty expanding nozzle openings to the first stage wheel, seventeen of which are controlled by valves, the three remaining openings being without valves, and consequently always open. When in operation, sufficient nozzle valves are opened to give the desired speed, the throttle valve being left wide open in order to secure full pressure in the steamchest. Variation in speed within limits may be made by throttle-valve regulation, but usually this is accomplished by opening or closing of nozzle valves.

Steam chests are of separate steel castings attached to each turbine-casing head. The astern chest contains the same number of nozzles as the ahead chest, but only eight are provided with valves. In maneuvering, nozzle valves are left open and speed controlled by throttle valves.

First-stage nozzles are of the expanding type, for the steam in its passage to the first revolving wheel undergoes too great a drop in pressure to permit the use of the parallel-flow type, which latter is used for all other stages, the drop in pressure being much less. Diaphragm plates have openings cast in them to allow passage of steam through to the nozzles.

Drain pipes are fitted between each stage and the succeeding one, in order that condensed steam in any stage may pass to the next one of lower pressure. The exhaust chamber drains to the condenser, and the discharge is assisted by a small steam ejector. Generally, however, this ejector is used only in getting underway, being closed off when the turbines have assumed normal working conditions.

PROPELLERS.

Prior to the official government acceptance trials of the *Salem* the contractors fitted and tried four different sets of propellers. The design which gave the best results (cast solid), and which was finally used, has the following principal dimensions:

TABLE III.—TOTAL STEAM CONSUMPTION FOR ALL PURPOSES (EXCLUSIVE OF LIFT PUMPS), AT SPEEDS FROM 10 TO 25 KNOTS.

Speed.	Steam used per hour (pounds).					Steam consumption in percentage, referred to Chester's 4-turbine combination as 100.				
	Birmingham.	Salem (second series).	Chester. Turbines in use.			Birmingham.	Salem (second series).	Chester. Turbines in use.		
			Six.	Five.	Four.			Six.	Five.	Four.
10 knots	34,000	44,000	43,200	45,500	46,600	73	94	93	98	100
11 knots	39,000	51,000	48,600	51,700	53,600	73	95	91	96	100
12 knots	44,700	58,200	54,700	58,100	61,200	73	95	89	95	100
13 knots	51,000	66,200	61,000	65,000	69,200	74	96	88	94	100
14 knots	58,000	74,700	68,200	72,300	77,700	75	96	88	93	100
15 knots	66,000	84,000	76,500	80,500	87,000	76	97	88	93	100
16 knots	75,300	94,200	86,500	89,500	97,000	78	97	90	92	100
17 knots	86,200	105,400	98,500	100,300	108,200	80	97	91	93	100
18 knots	98,600	118,200		111,400	120,000	82	98.5		93	100
19 knots	114,400	132,500		124,500	133,500	86	99		93	100
20 knots	134,000	150,000		138,500	148,500	90	101		93	100
21 knots	160,000	170,500		155,000	166,500	96	102		93	100
22 knots	192,000	195,000		173,500	187,000	103	104		93	100
23 knots	232,800	227,400			214,700	108	106			100
24 knots	285,500	273,000			254,800	112	107			100
24.5 knots		300,000			284,000		106			100
25 knots		329,000								

TABLE IV.—STEAM CONSUMPTION OF MAIN ENGINES AND TURBINES ONLY AT SPEEDS FROM 10 TO 25 KNOTS.

Speed.	Steam used per hour (pounds).					Steam consumption in percentage, referred to Chester's 4-turbine combination as 100.				
	Birmingham.	Salem (second series).	Chester. Turbines in use.			Birmingham.	Salem (second series).	Chester. Turbines in use.		
			Six.	Five.	Four.			Six.	Five.	Four.
10 knots	21,600	29,900	24,250	31,400	32,300	67	93	75	97	100
11 knots	26,200	36,100	30,200	36,900	38,900	67	93	78	95	100
12 knots	31,300	42,800	36,200	42,500	45,700	68	94	79	93	100
13 knots	36,900	50,000	42,500	48,800	53,000	70	94	80	92	100
14 knots	43,000	57,800	49,000	55,400	61,000	71	95	80	91	100
15 knots	50,400	66,700	56,200	62,800	69,800	72	96	81	90	100
16 knots	58,900	76,500	63,900	71,400	78,900	75	97	81	90	100
17 knots	68,800	87,300	73,900	81,100	88,900	77	98	83	91	100
18 knots	80,000	99,000	92,400	92,000	100,000	80	99	92	92	100
19 knots	94,500	112,000		104,200	112,000	84	100		93	100
20 knots	113,000	127,300		118,000	125,900	90	101		94	100
21 knots	136,500	145,200		133,000	141,800	96	102		94	100
22 knots	166,000	169,000		150.000	160,700	103	105		93	100
23 knots	203,200	199,000			184,500	110	108			100
24 knots	247,000	238,000			218,000	113	109			100
24.5 knots		261,800			244,000		107			100
25 knots		286.400								

Number of blades	3
Diameter feet and inches	9—6
Pitch, feet and inches	8—8½
Ratio, diameter to pitch	1.09
Area, projected, square feet	36.8
Area, helicoidal, square feet	43.7
Area, disk, square feet	70.9

CONDENSERS.

Two exhaust pipes connect each main turbine to a cylindrical, horizontal surface condenser, located in each engine room. In connection with each condenser, there is installed one Blake vertical dry-air pump, having one steam cylinder and one air cylinder, each double acting, operating on the same crank with fly-wheel between the two cranks. There is also a centrifugal wet vacuum pump for each condenser, of the two-stage type, directly connected and driven by a small two-stage (27 inch) Curtis turbine.

Number of tubes (each condenser)	4,448
Diameter of tubes (outside), inches	⅝
Thickness, B. W. G.	No. 16
Length, feet and inches	13—2
Cooling surface, square feet (each condenser)	9,460
Diameter exhaust, inlets (2), inches	42

There is an auxiliary condenser in the forward engine room and a condenser for the dynamo plant, both of which are similar in size to those heretofore described for the *Birmingham*.

BOILERS, FEED-WATER HEATERS AND BLOWERS.

The size and location of boilers, feed-water heaters and blowers are the same as on the *Birmingham*.

the port inboard by the low-pressure (port) turbine and the intermediate-pressure cruising.

The turbines may be used in any of three ways in propelling the vessel: First, for speeds up to about 18 knots all six turbines are put in operation, since this combination results in a smaller quantity of steam being required than with either of the other two combinations. Steam is then admitted initially into the high-pressure cruising turbine, exhausts into the intermediate-pressure cruising turbine, and from the latter splits and is conveyed through separate pipes to each of the main high-pressure turbines. From these latter steam is exhausted into the low-pressure turbines, and finally into the condensers. Second, for speeds beyond the capacity of the six-turbine combination, and up to about 23 knots, the five-turbine combination is used. Steam is admitted initially to the intermediate-pressure cruising turbine, passing thence to the two main high-pressure turbines, and from each of them to the connected low-pressure turbine. The high-pressure cruising turbine revolves idly in a vacuum. Third, for highest speed only the four main turbines are used, steam being admitted initially to each main high-pressure turbine, exhausted into the low-pressures, and then into the condensers. Both cruising turbines revolve idly in a vacuum, or may be disconnected by means of shaft couplings. It is to be understood, of course, that the four-turbine combination may be used for any speed up to the full power, just as the five-turbine combination may be employed for any speed up to its limit.

COMPILED FROM SUMMARY SHEETS OF COAL CONSUMPTION TESTS.

Test No.	Main air pumps.		Wet vacuum pumps.	Dry vacuum pumps.	Augmenters.	Main circulating pumps.			Steam consumption of main condenser auxiliaries (exclusive of main circulating pumps).			Steam consumption of auxiliaries necessary to propulsion.—includes main condenser auxiliaries; forced-draft blowers; oil pumps: Salem, Chester.			Steam consumption of auxiliaries not necessary to propulsion.			Total steam consumption of auxiliaries.		
	Birmingham.	Chester.	Salem.	Salem.	Chester.	Birmingham.	Salem.	Chester.	(a) Birmingham.	(c+d) Salem.	(b+e) Chester.	Birmingham.	Salem.	Chester.	Birmingham.	Salem.	Chester.	(n+q) Birmingham.	(o+r) Salem.	(p+s) Chester.
	a	b	c	d	e	f	g	h	k	l	m	n	o	p	q	r	s	t	u	v
1	2,220	3,550	958	2,600	1,971	985	1,230	800	2,220	3,558	5,521	5,705	7,963	9,006	8,018	6,978	5,899	13,723	14,941	14,905
2	2,400	2,600	974	2,636	2,032	1,060	1,560	1,160	2,400	3,610	4,632	7,696	11,951	9,314	8,157	6,190	5,006	15,853	18,141	14,320
3	2,970	4,850	1,099	2,598	1,890	1,460	3,360	1,900	2,970	3,697	6,740	13,930	20,412	15,680	7,244	7,184	5,641	21,174	27,596	21,321
4	4,540	5,500	1,662	2,585	2,291	2,050	3,380	3,585	4,540	4,247	7,791	35,883	40,532	30,840	3,578	3,584	3,215	39,461	44,116	34,055
COMPARISON OF ABOVE BASED ON BIRMINGHAM (AUXILIARIES) AS 100.																				
1	100	160	43	132	100	100	125	81	100	160	249	100	140	158	100	87	74	100	109	109
2	100	108	41	130	100	100	147	109	100	150	193	100	155	121	100	76	61	100	114	90
3	100	163	37	137	100	100	230	130	100	124	227	100	147	113	100	99	78	100	130	101
4	100	121	37	113	100	100	165	175	100	94	172	100	113	86	100	100	90	100	112	86

TABLE V.—STEAM CONSUMPTION OF AUXILIARIES IN POUNDS PER HOUR.

Chester.—The propelling machinery of the Chester, designed for a working steam pressure at the turbines of 250 pounds (gage) and about 507 revolutions per minute for the contract speed of twenty-four knots, consists of Parsons marine steam turbines, driving four independent shafts, each shaft being fitted with one propeller. The installation comprises six ahead turbines in all, two of which—the high-pressure and intermediate-pressure cruising—are for use at low powers in order to secure economy. There are also two backing turbines, located in each of the low-pressure casings, and it is to be observed that this arrangement permits reversal only of the two inboard shafts in maneuvering.

The outboard shafts are operated entirely by main high-pressure turbines; the starboard inboard by the low-pressure (starboard) turbine and high-pressure cruising turbine, and

In any of the three arrangements, increase or reduction of power is effected by throttling, though in the six-turbine combination a by-pass is fitted between the first and second expansion, which may be used, within limits, for this purpose. All maneuvering is done with the four main turbines only, and in event of either the six or five-turbine combinations being in use when a signal is received to go astern, a quick shift is necessary to cut out cruising turbines. This simply involves closing and opening proper valves, and need not require a greater interval of time than is usual in reversing machinery of the reciprocating type.

For the removal of water, all turbines have a connection to a system of drain piping leading to the main condensers. The outlet from each turbine is controlled by a valve which is always opened when warming up, and also on the cruising tur-

bines when underway in case these are not in use for propulsion.

Shaft gland boxes (twelve in all) are bolted to forward and after casing heads of each turbine. In order to prevent leakage a steam pressure of about 1 pound above the atmosphere is usually maintained in gland boxes when cruising, through a system of piping installed for the purpose.

The machinery is installed in two compartments, separated by an athwartship watertight bulkhead, the two cruising turbines, in addition to the starboard main high-pressure and low-pressure being located in the forward engine room. For the ahead motion the inboard shafts turn outboard, and the outboard shafts turn inboard.

The turbine cylinders are parted horizontally and the valves bolted together. The lower half is cast with extensions, box shaped forward and aft, for retaining the journal and thrust bearings.

Important data of turbine dimensions, stages, blading, etc., are shown below:

	Diameter of Rotor Drum.	Length of Rotor Drum.	DIAMETER OF CYLINDER FOR EACH STAGE.						
			1st.	2d.	3d.	4th.	5th.	6th.	7th.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
H. P. cruising......	60	36	60¾	61	61¼	..	..	..	..
I. P. cruising......	49	60.5	51¼	51⅞	52.5	..	..	..	..
Main H. P. (port and starboard)...	42	103.5	43¾	44.5	45.5	47	49	52	..
L. P. (port and starboard)..........	65	53⅜	70	72	75	79	79	79	79
Astern (port and starboard).......	50	43	51	52	54	54	54	..	..

Stages.	Expansions	Rows.	Heights.	Pitch.	Clearances.
H. P. Cruising.			Inches.	Inches.	Inches.
First....................	First.......	12	⅜	⅞	0.03
Second..................	Second.....	12	½	⅞	.035
Third....................	Third......	12	⅝	1	.04
I. P. Cruising.					
First....................	First.......	15	1⅛	1¼	.04
Second..................	Second.....	15	1 7-16	1¼	.04
Third....................	Third......	15	1¾	1 5-16	.045
Main High Pressure.					
First....................	First.......	12	⅞	1¼	.03
Second..................	Second.....	12	1¼	1¼	.035
Third....................	Third......	12	1¾	1 5-16	.04
Fourth..................	Fourth.....	12	2½	1⅜	.045
Fifth....................	Fifth.......	12	3½	1 7-16	.05
Sixth....................	Sixth.......	10	5	1 13-16	.05
Main Low Pressure.					
First....................	First.......	5	2½	1 5-16	.055
Second..................	Second.....	5	3½	1⅝	.06
Third....................	Third......	4	5	1 13-16	.07
Fourth..................	Fourth.....	3	7	1¾	.08
Do....................	Fifth.......	3	7	1 15-16	.08
Do....................	Sixth.......	4	7	2 5-16	.08
Do....................	Seventh.....	4	7	2 5-16	.08
Astern Turbines.					
First....................	First.......	6	½	1⅛	.045
Second..................	Second.....	6	1	1⅜	.05
Third....................	Third......	6	2	1⅜	.06
Do....................	Fourth.....	6	2	1½	.06
Do....................	Fifth.......	6	2	1½	.06

PROPELLERS (MANGANESE BRONZE, CAST SOLID).

Number of propellers....................	4
Number of blades (each propeller)........	3
Diameter, feet..........................	6
Pitch, feet.............................	6
Ratio of diameter to pitch..............	1
Area, projected, square feet............	17.02
Area, helicoidal, square feet...........	19
Area, disk, square feet.................	28.27

CONDENSERS.

The main condensers, one in each engine room, are located abreast the low-pressure turbines. They are cylindrical, of the surface-condenser type, and each is supplemented by a vacuum augmenter installed beneath the condenser. The augmenter consists of a steam siphon, drawing air from the main condenser and discharging it to the air-pump suction. The siphon discharge passes through a small surface condenser (which latter is supplied with circulating water by connection to the salt-water side of the main condenser), in order to condense steam of the siphon jet. The main air pump has a direct suction from the condenser through a pipe having a water seal, holding a head of water equal to the difference in pressure produced by the augmenter jet. It is figured that an increase in vacuum of approximately 1 inch of mercury results from the use of the augmenter.

There is one auxiliary and one dynamo condenser, located in the forward engine room and dynamo room, respectively, both similar and of the same dimensions as those previously described for the *Birmingham* and *Salem*.

The principal tube data of each main condenser are:

Number of tubes..............................	5,630
Diameter (outside), inches...................	⅝
Thickness, B. W. G...........................	No. 18
Length of tubes, feet and inches.............	10—0¼
Spacing (between centers), inches—Upper half..	1 x 1⅛
Lower half................	1 x 1
Cooling surface, square feet.................	8,999
Exhaust inlets (rectangular), feet and inches..	3—9 x 4—6

FEED-WATER HEATERS.

A cylindrical feed-water heater, composed of 630 ⅝-inch tubes and containing about 600 square feet of heating surface,

TABLE VI.—COAL CONSUMPTION TESTS.

No. of test.	Approximate speed.	Duration of test in hours.	Birmingham.				Salem.				Chester.			
			Average pressure in fireroom in inches of water.											
			Number of boilers in use.	No. of fireroom.			Number of boilers in use.	No. of fireroom.			Number of boilers in use.	No. of fireroom.		
				1	2	3		1	2	3		1	2	3
1	10	96	3	......	......	0.694	4	......	0.325	......	4	......	......	......
2	15	50	8	......	0.546	.788	8	......	.407	0.418	7	......	......	......
3	20	98	12	1.227	1.214	1.174	12	1.57	1.58	1.554	12	......	......	[a] 0.9
4	(b)	c24	12	5.077	4.942	5.807	12	5.08	4.84	5.11	12	3.03	3.03	3.03

TOTAL EVAPORATION PER HOUR—BLOWER STEAM—NET AVAILABLE STEAM.

			Total evaporation.	Blower steam.	Net available steam.	Total evaporation.	Blower steam.	Net available steam.	Total evaporation.	Blower steam.	Net available steam.
			A[d]	B[e]	(A-B)[f]	C[d]	D[e]	(C-D)[f]	E[d]	F[e]	(E-F)[f]
1	10	96	32,871	990	31,881	44,674	873	43,801	36,097	....	36,097
2	15	50	67,438	1,961	65,477	84,280	2,219	82,061	74,596	....	74,596
3	20	98	129,176	5,200	123,976	163,111	7,385	155,726	134,270	525	133,745
4	(b)	c24	271,545	18,493	253,052	293,103	24,820	268,283	314,161	6,510	307,651

PER CENT OF TOTAL EVAPORATION PER HOUR—BLOWER STEAM—NET AVAILABLE STEAM.

1	10	96	100	3	97	100	2	98	100	0	100
2	15	50	100	3	97	100	3	97	100	0	100
3	20	98	100	4	96	100	4	96	100	0.4	99.6
4	(b)	c24	100	7	93	100	8	92	100	2	98

[a] Forced draft used intermittently 50 hours.
[b] Maximum speed: Birmingham, 24 knots; Salem, 24.32 knots; Chester 25.08 knots.
[c] Birmingham discontinued this trial after twelve hours
[d] Total water evaporated per hour, in pounds.
[e] Steam used per hour by forced draft blowers, in pounds.
[f] Net available steam per hour, in pounds.

is located near the forward bulkhead of each engine room on the discharge side of the main feed pumps. The heating agency is steam from the auxiliary exhaust line, which enters the shell at the top, circulates around the tubes over a system of baffles, and drains through a trap to the main drain line. The tubes, through which the feed water passes on its way to the boilers, contain twisted brass trips, held in place by perforated plates over the tube sheets to retard the flow and thus insure efficient heating. A small air coil is fitted in the lower water chest, to prevent the heater from becoming air bound. This coil is connected to the inside of the heater shell, near the bottom, and drains to the main condenser.

BOILERS.

The gases of combustion make but a single pass across the tubes in their exit to the up-takes. It is to be noted, further-

more, that, although the grate surface is the same in the boiler installations of all three vessels, the *Chester's* boilers contain but 32,040 square feet of heating surface, as against 37,992 square feet in the boiler plants of the *Birmingham* and *Salem*.

FORCED-DRAFT BLOWERS.

The system of forced draft used on the *Chester* is similar to that on the other scout vessels. It is of the closed fire-room type, there being two blowers (six in all) 84 inches in diameter for each boiler compartment. Each blower is driven by a vertical two-cylinder (5 by 5), simple double-acting steam engine, with one piston valve to each cylinder. The blowers are arranged in pairs near the fore and aft center line of ship, with a connecting shaft between each two fans, so that both fans run at the same speed, and in event of accident to one engine the remaining engine may be utilized to operate both fans.

MACHINERY WEIGHTS.

Weight of the propelling machinery, shafting, bearings and propellers is as follows:

	Tons
Birmingham (2 shaft reciprocating engine arrangement)	234.49
Salem (2 shaft Curtis turbine arrangement)	254.80
Chester (4 shaft Parsons turbine arrangement)	207.38

Weight per horsepower (the maximum power of main engines or turbines for two consecutive hours during either steam or coal consumption trials) is:

	Pounds.
Birmingham (16,134), per I. H. P.	32.55
Salem (18,070), per S. H. P.	31.58
Chester (20,004), per S. H. P.	23.22

The weight of appendages (auxiliaries) to the above propelling machinery, including main condensers, air pumps, circulating pumps and dry vacuum pumps or vacuum augmenters, is as follows:

	Tons.
Birmingham	45.13
Salem (fitted with dry-vacuum pumps)	67.63
Chester (fitted with vacuum augmenters)	58.19

The boilers, fittings, smoke pipes and up-takes weigh as follows:

	Dry.	Wet.
	Tons.	Tons.
Birmingham (12 Fore River boilers, 4 smoke pipes)	262.51	94.14
Salem (12 Fore River boilers, 4 smoke pipes)	262.61	94.24
Chester (12 Nomand boilers 4 smoke pipes)	272.70	307.01

Weight of boilers with fittings and water in pounds per square foot of heating surface is:

	Pounds.
Birmingham	13.10
Salem	13.09
Chester	17.64

The total weight of machinery installation, including propelling machinery and appendages, auxiliary machinery, piping, boilers and fittings, smoke pipes and up-takes, lagging and clothing, flooring, ladders and gratings, fittings and gear, stores, tools and spare parts carried on board, and pipes, etc., connecting to machinery not under the cognizance of the Bureau of Steam Engineering, is as follows:

	Dry.	Water.	Total.
	Tons.	Tons.	Tons.
Birmingham	760.82	53.15	843.97
Salem	853.85	55.11	908.96
Chester	735.87	64.82	800.69

The weight per horsepower (main propelling machinery only) of all machinery (wet) is:

	Pounds
Birmingham (14,134), per I. H. P.	117.18
Salem (18,070), per S. H. P.	112.68
Chester (20,004), per S. H. P.	89.67

RESULTS OF TESTS.

The data obtained from the different series of tests are voluminous, and for the complete details the reader is referred to the report itself, which may be obtained from the Navy Department. The principal result of the tests, however, have been summarized and condensed in the tables which are shown in Tables I.-VI.

CONCLUSIONS.

The following conclusions are based on results of tests described in this report:

Main Propelling Machinery.—Tables III. and IV. have been compiled from curves plotted, and show at a glance for the three vessels, respectively, the weight of steam required per hour for all purposes as well as the amount used by the main engines or turbines only for speeds from 10 to 25 knots, at knot intervals, together with a percentage comparison based on the *Chester's* four-turbine combination.

An examination of Table III. shows that, based on total steam used for all purposes (excluding lift pumps), the *Birmingham* is the most economical of the scout vessels up to (a) 20.6 knots (50 percent of designed power of main engines). Above that speed the *Chester,* using the five-turbine combination, becomes the most economical, and at (b) 21.6 knots the four-turbine combination is more economical than the *Birmingham's* reciprocating engine installation. Up to (c) 22.25 knots, the *Birmingham* is more economical than the Salem (second series of tests), but above this speed the *Birmingham* becomes the least economical of the three vessels. Due probably to excessive gland leakage, the *Chester's* six-turbine combination is less economical than the five-turbine combination above (d) 17.4 knots; the five-turbine combination, up to the limit of its speed, is invariably more economical than the four-turbine combination. The *Chester's* four-turbine combination is less economical than the *Salem's* installation up to (e) 19.45 knots, but more economical above that speed.

Based on steam used at various speeds per hour by the main propelling machinery only (exclusive of all auxiliaries) the figures above stated change but slightly. Using reference letters as in the previous paragraph, the figures become (a) 20.6, (b) 21.5, (c) 22.45, (d) 18.0, (e) 18.9.

Auxiliary Machinery.—Conclusions as to relative steam consumptions of auxiliaries, for accuracy of comparison, should be based upon close regulation of such machinery in accordance with actual requirements. The quantity of condenser cooling water required, to cite an example, is largely dependent upon sea temperature, and in consequence this becomes a controlling factor in speed of circulating pumps. Moreover, for each speed of vessel, under conditions existing at the time, there is a point of regulation which gives minimum steam expenditure for each auxiliary. On main (IV.) steam-consumption tests close regulation of auxiliaries was not attempted, but on coal-consumption tests every effort was made to reduce steam thus expended to a minimum. Comparisons therefore are based upon results of these trials as shown in detail in Table V.

The various auxiliary machinery installed on the three vessels may be classed arbitrarily under the following three heads: (1) Like auxiliaries whose steam consumption depends largely upon efficient condition of working parts and speed of operation, and which class includes a large percentage of the auxiliaries of the three ships. Steam expenditure for these auxiliaries should not be widely different under like conditions of use. (2) Main condenser auxiliaries. Disregarding steam used by main circulating pumps, it will be seen in Table V. that the *Birmingham's* condenser equipment required the least steam expenditure during all trials, except at full power, when

the *Salem* used 6 percent less. The greatest exenditure was on the *Chester*, indicating that the *Salem's* wet-and-dry vacuum pumps are less expensive in steam used than the *Chester's* augmenters and air pumps. It should be pointed out, furthermore, that with exception of circulating pumps, which are similar, the main condenser auxiliaries differ radically in type, which makes comparison of their steam expenditures desirable and important. (3) Forced draft blower installations: Based on steam consumption per hour per indicated horsepower, the *Chester's* equipment shows a variable gain in economy, as compared with the other two vessels, of percent at low powers (5 indicated horsepower), extending to 16 percent at high (35 indicated horsepower) powers.

PROPULSIVE EFFICIENCY.

Due to dissimilar propeller effciencies, it is obvious that comparison based on steam consumption of the machinery (either main or inclusive of all auxiliaries) per hoursepower would not indicate the relative economies of the three vessels with the same degree of accuracy as the steam used per knot. As illustrating this results of coal-consumption trials may be cited: For example, on trial No. 3 (about 20 knots) the average horsepower (shaft) of the main engines or turbines necessary to propel each of the three vessels, as recorded in Table O, is, *Birmingham*, 7,120.5; *Salem*, 6,883.3; *Chester* (five-turbine combination), 8,374.

BOILER INSTALLATIONS.

In order to effect a true comparison covering steam-generating appliances on the scout vessels it is essential to take into consideration not only boiler efficiencies, but, as well, expenditures of steam (forced-draft blowers) necessary in conjunction with service operation of the plants. Differences in boiler design have been pointed out, and it is to be noted that, due to tortuous passage of gases of combustion across heating (tube) surfaces of the boilers of the *Birmingham* and *Salem* higher fire-room air pressures must be maintained compared with the *Chester's* boiler installation to burn the same weight of coal.

The results of the tests show that under similar conditions as to air pressure there is a wide difference in the amount of coal consumed. It may be further pointed out, in this connection, that on 10 and 15-knot coal-endurance runs the *Chester* steamed under natural draft, while on the other two vessels with the number of boilers in operation forced draft was a necessity. It will be apparent, therefore, that comparison of steam-generating apparatus should be based upon percentage of available net output of steam, in addition to boiler efficiency, as recorded in Table VI, compiled from results of coal-consumption tests.

Regulation of Motor Boats.

An act to amend the laws for preventing collisions of vessels and to regulate the equipment of certain motor boats on navigable waters of the United States went into effect July 9, 1910.

The motor boats subject to the provision of this act are divided into three classes: First, those under 26 feet in length; second, 26 feet or over and less than 40 feet in length; third, 40 feet or over and not more than 65 feet in length.

The act provides that every motor boat in all weathers, from sunset to sunrise, shall carry the following lights, and during such time no other lights which may be mistaken for those prescribed shall be exhibited:

Every motor boat of class 1 shall carry the following lights:

First. A white light aft to show all around the horizon.

Second. A combined lantern in the fore part of the vessel and lower than the white light aft showing green to starboard and red to port, so fixed as to throw the light from right ahead to two points abaft the beam on their respective sides.

Every motor boat of classes two and three shall carry the following lights:

First. A bright white light in the fore part of the vessel as near the stem as practicable, so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, namely, from right ahead to 2 points abaft the beam on either side. The glass or lens shall be of not less than the following dimensions: Class 2, 19 square inches; Class 3, 31 square inches.

Second. A white light aft to show all around the horizon.

Third. On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side. On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side. The glasses or lenses in the said side lights shall be of not less than the following dimensions on motor boats of Class 2, 16 square inches; Class 3, 25 square inches.

On and after July 1, 1911, all glasses or lenses prescribed for boats in Classes 2 and 3 shall be fresnel or fluted. The said lights shall be fitted with inboard screens of sufficient height and so set as to prevent these lights from being seen across the bow, and shall be not less than the following dimensions: On motor boats of Class 2, 18 inches long; Class 3, 24 inches long;

Provided, That motor boats as defined in this Act, when propelled by sail and machinery or under sail alone, shall carry the colored lights suitably screened but not the white lights prescribed by this section.

Every motor boat under the provisions of this Act shall be provided with a whistle or other sound-producing mechanical appliance capable of producing a blast of two seconds or more in duration, and in the case of such boats so provided a blast of at least two seconds shall be deemed a prolonged blast within the meaning of the law.

Every motor boat of Class 2 or 3 shall carry an efficient fog horn.

Every motor boat of Class 2 or 3 shall be provided with an efficient bell, which shall be not less than 8 inches across the mouth on board of vessels of Class 3.

Every motor boat subject to any of the provisions of this Act, and also all vessels propelled by machinery other than by steam more than 65 feet in length, shall carry either life-preservers, or life belts, or buoyant cushions, or ring buoys or other device, to be prescribed by the Secretary of the Commerce and Labor, sufficient to sustain afloat every person on board, and so placed as to be readily accessible. All motor boats carrying passengers for hire shall carry one life-preserver of the sort prescribed by the regulations of the Board of Supervising Inspectors for every passenger carried, and no such boat while so carrying passengers for hire shall be operated or navigated except in charge of a person duly licensed for such service by the local board of inspectors. No examination shall be required as the condition of obtaining such a license, and any such license shall be revoked or suspended by the local board of inspectors for misconduct, gross negligence, recklessness in navigation, intemperance, or violation of law on the part of the holder, and if revoked, the person holding such license shall be incapable of obtaining another such license for one year from the date of revocation: *Provided*, That motor boats shall not be required to carry licensed officers except as required in this Act.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

A Broken Bilge Pump Chamber Bottom.

It may be interesting to marine engineers to relate a simple repair which can be made to a broken bilge pump or feed pump chamber bottom. It sometimes happens that a hole is knocked in the metal of such a casting, either due to wearing action reducing the thickness and strength of the metal or to an originally faulty casting. This difficulty will usually show itself when the engines are racing in a heavy head sea, and, as a rule, not much leisure is available for an elaborate repair.

The trouble may, however, be remedied in either of the following ways: One method is to take a piece of rubber valve sufficiently large to overlap the hole, and to place this over in the pump chamber. A piece of flat iron plate should be put under this to support the rubber and give it stiffness,

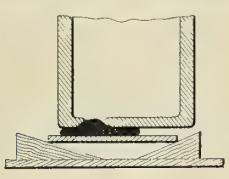


FIG. 1.

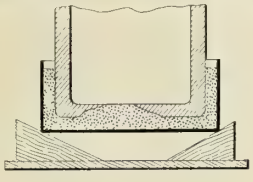


FIG 2.

and this plate can then be wedged up tight by means of wedges placed between it and the tank top or platform. The rubber expands up into the hole and forms a watertight plug, as shown in Fig. 1.

Another method which may be adopted, if it is possible to stop the engines, and there is not too much water about, is to get a meat tin or other receptacle which is sufficiently near the size of the chamber end to pass over it. About ½ inch of good Portland cement should be placed in the bottom of the tin, this cement being mixed rather stiff. The tin should then be slipped over the end of the pump chamber and shored up from the tank or platform, as shown in Fig. 2. If a sufficient amount of time is given for this quick-setting cement to become hard it will be found that a good sea-going repair job has been effected, which will be sufficiently strong to enable the boat to be brought to port.

Charles De Groot.

Southampton.

Steering by Means of a Jury Rudder.

One of the accidents which may befall a small boat, such as a fishing trawler, when at sea, is the loss of the rudder, and as such an occurrence may happen when the boat is a considerable distance from shore it may result in much inconvenience, and even danger. It may therefore be interesting to narrate the steps which were taken in order to overcome such a difficulty in the case of a steam trawler about 150 feet long which lost its rudder when it was about 400 miles from any port. The repairs had, of course, to be executed by means of such material as was available on board the vessel, and this did not offer a very wide selection. A few planks of wood which were on board the boat were bound together so as to form a surface approximately equal to the superficial area of the lost rudder. To the center of the board, near to its top edge, a steel hawser about 10 feet long was attached, the other end being fixed centrally to the stern of the vessel. At the two outside edges of the board two other steel hawsers were led aboard to the winch, which, as installed on these boats, is placed near the stern, and has a double barrel. The bottom edge of the board was weighted by means of the lead weights used in the trawling nets, so that when placed in the water it hung vertical. It will be seen that when there was any way on the vessel the central steel hawser took the strain and the jury rudder was formed, while the angle of inclination of the rudder to the course of the vessel was adjusted by means of the auxiliary side hawsers operated from the winch.

It was found that this arrangement operated very well in practice, and the boat was brought safely to port over a distance of 400 miles. The only danger which could acrue from such an arrangement would be the possibility, in a heavy following sea, of the jury rudder being washed with violence against the stern of the vessel, but circumstances were favorable to this form of construction being used.

Observer.

A Broken Guide Shoe.

The friction which occurs on marine engines between the guide and guide plate is a somewhat serious matter in spite of careful attention to efficient lubrication, and quite a perceptible amount of horsepower is used in overcoming internal loss due to this cause. Considerable attention has, however, been paid in design, not only to reducing the superficial area of the guides to as small an amount as is consistent with safety, but also to introducing metals which have surfaces which are not so susceptible to the abrasion which occurs when steel rubs against steel. For this reason the guide shoes are sometimes fitted with horizontal bars of white metal, dovetailed into the steel castings; these bars projecting slightly above the surface of the casting. As a rule the dovetail is about ⅜ inch thick, while the total thickness of the steel shoe is from

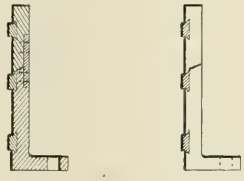


FIG. 1.

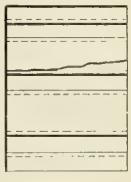


FIG 2.

1 inch to 1¼ inches. It is important that a very good factor of safety should be given in designing this depth, as will be evident from the following description of trouble occuring on such a guide shoe.

During bad weather, when a certain steamship was pitching and the engines racing badly, throwing great stresses on the guides, the shoe broke in two, as shown in Fig. 1. This was partly owing to the fact that the dovetail was made too deep and partly because a badly-fitting liner was placed behind the same. If these liners are not cut exactly the same size as the crosshead the latter will have a spring where the liner is not bearing. In this particular case the bottom half dropped into the oil-comb box, and on the next down stroke broke this away, dropping the piece of shoe into the crank pit. This made a rather difficult piece of repair work, inasmuch as there was now apparently no space on which to put a patch. The difficulty was, however, overcome as shown in Fig. 2. A recess

was cut in the metal of each of the severed halves of the guide shoe ¼ inch deep, the cut extending to about 2 inches on each side of the crank. Clearing holes were then drilled in the plate, and the shoe was marked off from these, tapping holes being then inserted in the guide. These holes were ⅜-inch clearing and tapping respectively. Muntz metal studs were then screwed in, leaving sufficient of the metal projecting for clinching. The plate was then tightened up and the studs riveted over so as to leave everything flush. The patched guide shoe was then replaced on the engine, and on trying the work the engine ran as if a new shoe had been used. S. R. S.

A Series of Mishaps.

Perhaps no saying is more correct with regard to "breakdowns," and especially minor accidents, than "Misfortunes never come singly," for the following five mishaps occurred on a vessel which I served in as third engineer in the early part of my sea-going career. At the time the vessel, which was a British tramp of the usual class at that period, was about 12 years old; she had been, and then was, engaged in the frozen meat trade between South America and England, we had three engineers on the main and two for the refrigerators, all being under the command of the chief of the main. The vessel had two boilers for the main engines, which were compound, and a smaller one for the freezing engine. The small boiler, however, was too small to drive that engine when exhausting on the atmosphere, and a donkey boiler was also fitted.

The following five mishaps occurred within a week; three taking place the first day, which, as is usual when breakdowns take place, was Sunday, and we were just about at the Equator, homeward bound.

Just before 8 A. M. the second engineer was surprised to find the engine-room bilges (there being no engine-room tank) rapidly filling with sea water; upon investigation it was found that the suction pipe for the cooling water to the freezing engine had "parted" from the main engine's injection pipe, to which it had been brazed as a cheap alteration when the freezing installation had been fitted.

As it was imperative that the freezing engines should not be stopped for longer than two hours, it was necessary to make a prompt repair; the freezing engine, I may say, exhausted into the main condenser, and, as the steam was generated in the small boiler, gave us an ample supply of fresh feed.

To keep the refrigerator running we gave steam from the starboard main boiler, and then commenced to repair the damaged pipe. Fortunately, about 18 inches above the topside of the injection pipe to which the suction pipe had been brazed there was a flange and another length of pipe. We simply fitted two wood "shores" in between the fore-and-aft girder on the ship's side to secure the pipe in its place, stopped up the holes in the bilge limber intercostals, wrapped the joint between the suction and injection pipes with white lead canvas and spun yarn, and buried the whole in Portland cement, which allowed us to work quite well until our arrival in Liverpool.

While we were engaged on the above repair we were surprised to hear the port boiler safety valve blowing off. Worse again, we found in spite of all coaxing we could not stop it. Our chief then decided to blow off the steam and examine the safety valve springs. As the freezing engine exhaust steam pipe discharged into the one waste steam pipe it was absolutely necessary to stop the machine, and being in the tropics, as well as on the boiler tops, it can be easily understood it was no soft job which fell to the lot of the "third." We examined the valve and springs, and, strange to say, found nothing wrong. Some pieces of dirt must have got under the valve when it first lifted, and had fallen back when the springs were being slackened. However, after closing up the valves and completing the pipe repair, we got under way about 3 P. M., all working very nicely after the fires got well under way.

About 8 P. M. the same Sunday we were again called out, as our old-time single-acting circulating pump ceased working satisfactorily. On examination we found the studs (⅞-inch brass) which held the foot valve in its place had come out of the cast iron ridge into which they were fitted. Parts of this ridge had crumbled away, and altogether the metal was too much deteriorated to fit new studs. Not only this, the foot valve itself, as well as the guards for the fiber valves, was broken into quite a number of pieces. It was decided that the best way to do was to try and dispense with a foot valve. This was done, and we got under way about 10 P. M.

Everything worked well until about Wednesday, I think, when, no doubt partly owing to being without a foot valve in the circulating pump, and mostly owing to the rotten condition of the injection pipe, the latter pipe burst in about the middle and was badly misshapen. It was so thin and tender it was almost beyond repair. This we rectified by tapping it in with a piece of wood into something like its former shape, wrapping it with several layers of canvas and wrapping it from end to end with flat-spun yarn, then we melted all the tallow we had, and poured it over the wrapping, smoothing it while hot with thin pieces of smooth wood. Our stock of Portland cement was exhausted, else we could have buried part of the pipe in cement; yet our repair held out until we reached Liverpool. This accident, of course, caused another stoppage of about four hours.

Finally, to crown all, on Saturday afternoon, shortly after dinner, a fireman asked me to go into the stokehold as steam was coming from under the stokehold plates at the end of the port boiler. This I did; and on examination I found it to be coming from the boiler, but exactly where it was hard to say. In accordance with standing orders I advised the chief engineer. As soon as he saw this development he, of course, at once ordered the steam to be blown off, fires drawn, and the boiler emptied. The boiler end was found to be in such a poor state that a chisel was easily knocked through. The method by which we repaired this was to take the largest piece of plate we had, which happened to be ⅝ inch thick; bend it to fit the radius of the boiler shell and also the shell and end; drill holes and mix red lead cement and leased out spun yarn together; cut holes with a round-nose chisel in the boiler end, and rejoint our plate in position. We then, fortunately, obtained from the deck department some old Portland cement they had stowed away and covered our repair with it. We then reduced our 80 pounds pressure to 45, and crawled home, where new half-end plates were put in both boilers. The circumferential seam at the end of this boiler had been cemented over some time, the cement having been displaced, and further deterioration taking place on the outside of the end plate, and doubtless owing to firemen throwing water on clinker and ash when cleaning fires caused this leak to show. Had it not been observed when it was, and promptly attended to, a very serious and probably a fatal explosion would have taken place. Third Engineer.

An Experience with a Broken Propeller.

An instance occurred where a propeller was broken while a vessel was leaving port for sea. The ship did not, of course, proceed to sea but remained behind for examination, but as there was no drydock or proper engineering appliances beyond the assistance of a small blacksmith's shop, the case was sufficiently rigorous. The blacksmith's shop was only available for making a few tools for the occasion. The accident occurred through the vessel swinging round on to the piles of a wharf owing to the breaking of the tow rope when the order to go ahead was given by the telephone. The starting

of the engines caused the propeller to strike the piles, with the result that it was broken, each blade having more or less metal taken off; two of the blades were broken off close to the boss.

The repairs were carried out by the engine-room staff, since there were no facilities at the port. The vessel had to be dipped by filling the forehold with water and by pumping the after ballast tanks out. It was perhaps fortunate that the ship was in ballast, having just discharged her cargo. Sufficient water was pumped into the forehold to bring the ship up by the stern and down by the head, and when the boss of the propeller was clear above the water pumping was stopped. In the meantime the last two couplings of the shaft were disconnected and the last length of shafting rolled out of its place. This made room for the tail shaft, which was drawn in to be surveyed.

Before this, however, the propeller had to be taken off, which involved some considerable time. A fire had to be lighted under the propeller boss in order to cause it to expand. Fouling keys and drafts were made for the occasion, and strong backs had to be cut and made to fit between the tail shaft coupling and the inside of the end of the stern tube. These strong backs were 4 inches in diameter. The fouling keys and drifts were driven behind the boss of the propeller, the fire being kept going for a day to get the boss hot. After a considerable amount of hard hammering with heavy hammers the propeller was in a position to be removed. This was, of course, held in slings from patent blocks swung over the ship's quarter. These were paid out and the propeller loaded into a punt or raft. The spare propeller was also hauled out of the hold and lowered onto the raft.

The lifting of the weights and the choice of tackle were subjects of rather special consideration, as very great care had to be exercised. The derricks were strengthened to lift the propellers, and everything was lifted with safety appliances adopted to prevent accident to life or property.

After the tail shaft had been drawn in, cleaned and examined, it was replaced, and the spare propeller lifted up by the patent blocks and entered on the shaft; the nut was then put on and tightened up, everything being carried out without a hitch in a satisfactory manner. T. W. Wilson.

Liverpool.

Broken Air Pump Head Valve and Repairs Effected.

Sometime since when on a trip from Cardiff to River Plate, and about half-way on our journey, a fearful rattle was heard suddenly in the air pump. The hot well was not overflowing, but the vacuum was going back. We stopped the engines and proceeded to overhaul the air pump. We found the head valve in about a hundred pieces; in fact, no piece was too large to go into an ordinary bucket. One could sarcely realize the complete collapse in so short a time without having seen the damage done.

Our method of repair was as follows: We obtained two pieces of 12-inch by 22-inch plank; cut two pieces the necessary length, and cut them in a circle the proper diameter to rest on the top of the air pump chamber. We secured the two pieces of wood together with long wood screws. We then cut two pieces of 1/8-inch iron plate the same diameter, cutting holes for water passages through bolts to secure the wood and iron plates, and also holes for bolts to secure the valves and guards and one in the center for the rod. We then bolted the whole together and got the carpenter to bore and cut holes through the wood to correspond with the holes in the plates.

We used 1/2-inch bolts to secure the plates and wood together and 3/4-inch bolts to hold the valves, which were spare ballast donkey india rubber valves about 5/8-inch thick. We cut up a piece of iron pipe for distance pieces, and some 1/8-inch Muntz metal discs were used and bolted hard down on the distance pieces, allowing about 1/16-inch play for the lift of the valves. We replaced this head valve, and then cut some washers to "line up" between the head valve and the neck on the air pump cover, and so jammed the head valve securely. This repair steamed us a distance of over 8,000 miles, and when taken out was as good as ever, and had worked without any trouble. Engineer.

How to Deal with a Split Smoke Tube.

A split smoke tube in a marine boiler is a very common occurrence even on board a ship which has only just been put into commission, and it is needless to say that when this happens a very considerable loss may result in delay to the ship and in increased consumption of coal. So much is this recognized that a good many boats carry patent tube stoppers, and when these are available the trouble is very simply overcome. Some engineers, however, on board vessels which are not so excellently equipped have not these facilities at hand, and even supposing that there was sufficient gear on board to enable the engineers to make a proper tube stopper it would occupy at least a few hours to do it.

For this reason it may be interesting to detail an old plan, and yet a very good one, which not every engineer knows about, in order to stop trouble due to this cause in a rough-and-ready manner. When such a tube splits, the first thing to do is to take a piece of soft wood, slightly less than the diameter of the tube. The wood should be about 3 inches long, with a recess in the middle of it about 1 inch less in diameter, and about 1 inch in length. The next step is to locate the position of the leaking part of the tube. This can be done by slowly pushing a piece of broomshank along the leaky tube until there is a change in the sound of the hissing noise made by the escaping steam. This will indicate that the end of the broomshank has just reached the leak, and that the steam is playing upon it. After finding the distance along the tube, the piece of wood, which has been prepared, should be pushed in until the recessed part is under or about the leak. It will be found that after a few hours' running the soft wood will swell, owing to the presence of the steam, and the leak will salt up. When this occurs a temporary repair will have been effected.

In the meantime it may be advisable for the engineer to make some tube stoppers in the following way: A length of iron, 7/8 inch or 3/4 inch in diameter, should be taken, a rake handle or slice bar will do quite sufficiently well. The ends of the bar should be threaded about 6 inches down, leaving a square at one end, which will be kept to the front of the boiler for holding on to in case the bolt turns when the stopper is being put into position. Four iron washers should then be made, of a diameter slightly less than the diameter of the tube; and between each pair of these washers, which are placed at the ends of the bar, must be fitted a rubber washer, made from circulating or air-pump valves, for the purpose of being squeezed out to the size of the tube. Between the washers at each end another piece of tube of any convenient size should be placed to act as a distance piece. This tube stopper should be placed into the tube past the leak with all washers in position, and screwed up from the front until the expansion of the rubber washers makes a tight joint. A variation on this practice, which is sometimes used by engineers who do not think that a rubber washer is sufficiently durable, is to use a lead washer in place of the rubber; but the principle is the same, and in practice the above-described repair is found to be extremely useful in emergency. Apprentice.

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Shipbuilding.

Some indication of the trend of shipbuilding is afforded by two reports which have just come to hand. One of these is the yearly shipbuilding report for the fiscal year ending June 30, 1910, issued by the Bureau of Navigation, Department of Commerce and Labor of the United States, and the other is the quarterly report from Lloyd's Register for the quarter ended June 30, 1910.

According to the Bureau of Navigation report, during the year ended June 30, 1910, there were built in the United States and officially numbered by the Bureau of Navigation 1,502 merchant vessels of 347,025 gross tons compared with 1,362 of 232,816 gross tons during the fiscal year of 1909, showing a substantial increase of 114,209 gross tons, or 49 percent. Forty-four steel steamships, aggregating 82,333 gross tons were built on the Atlantic and Gulf coasts, as compared with 23 ships of 28,613 gross tons in the previous year, making an increase of about 190 percent. Similarly, the steel steamship tonnage built on the Great Lakes advanced from 36 ships, aggregating 88,426 gross tons in 1909, to 47 ships aggregating 146,896 gross tons in 1910, an increase of 58,470 gross tons, or 66 percent. On the whole, therefore, shipbuilding in the United States has shown a very marked and encouraging advance, particularly in the coast yards. Although many inquiries for new tonnage have been received during the last few months, comparatively little new business has been closed recently, and the prospect of the increased activity becoming permanent is none too bright. Practically all of the new construction is for coastwise trade.

On turning to the quarterly returns of Lloyd's Register, we find that excluding warships, there were 394 vessels of 1,118,587 gross tons under construction in the United Kingdom at the close of the quarter ended June 30, 1910. The tonnage now under construction is about 61,000 tons more than that which was in hand at the end of last quarter, and exceeds by nearly 373,000 tons the total building twelve months ago. The figures of the warship tonnage now being built, which amount up to 378,523 tons displacement, are the largest reported since June, 1901. The Belfast and Glasgow districts show the greatest activity, although nearly every important shipbuilding center shows the same substantial advance over the amount of work in hand for the same quarter of the previous year.

After the extremely low returns which have been reported by Lloyd's during the years of 1908 and 1909, the present activity is very encouraging, especially as there does not seem to be any immediate prospect of its ending. On the whole, the situation in the shipbuilding industry, as far as the construction of new tonnage goes, is far more encouraging to-day than it has been any time during the past two years, although, of course, compared with the great volume of business in hand five years ago, these figures are by no means startling.

The New Bureau of Lighthouses.

Sweeping changes in the administration of the United States Lighthouse Establishment were inaugurated recently by the enactment of a law creating a Bureau of Lighthouses, headed by a Commissioner of Lighthouses, to perform the duties and exercise the power and authority previously held by the Lighthouse Board. This change is in accordance with the method of managing most of the departments which come under the administration of the Secretary of the Department of Commerce and Labor, and should prove a satisfactory and efficient solution to the problem of caring for the lighthouse establishment. The bill provides not only for a Commissioner of Lighthouses, but also for a Deputy Commissioner, both of whom are to be appointed by the President, also for a Chief Clerk, Inspectors, Clerical Assistants, and other employees necessary to carry on the business of the department. Two other important officers are provided

for, one of which is the Chief Constructing Engineer and the other the Superintendent of Naval Construction, both of which positions are to be filled by appointment by the President. The former carries a salary of $4,000 (£823), per annum and the latter, $3,000 (£615) per annum. The new Commissioner of Lighthouses is authorized, subject to the approval of the Secretary of Commerce and Labor, to rearrange the ocean, gulf and lake coasts, and the rivers of the United States, Porto Rico and the naval station in Cuba into not exceeding nineteen lighthouse districts, and a lighthouse inspector is to be assigned in charge of each district. These inspectors are to receive a salary of $2,400 (£493) a year, except the inspector of the third district, whose salary is to be $3,600 (£740) a year. At the discretion of the President, army and navy officers may be appointed to act in place of civilian inspectors for the next three years, if it seems desirable.

This reorganization of the Lighthouse Department will undoubtedly result in increased efficiency in the maintenance of this important branch of federal activity, and mariners can rest assured that nothing which can be done will be left undone to safeguard navigation in American waters.

Torpedo Boat Destroyers.

An article in this issue on modern torpedo boat destroyers, calls attention to the relative number of such vessels owned by the leading naval powers, and from this comparison it is evident that while almost without exception the number of destroyers in any navy bears a fixed relation to the number of capital ships in the navy, yet there is one exception, and that is the United States, which is undeniably weak in this branch of naval service.

The characteristics of the modern destroyer are thoroughly discussed in the article to which we refer, and it is pointed out that the tendency is in the direction of higher speeds, larger displacements and a greater radius of action. These features have been developed in order to enable the destroyer to remain at sea with a battleship fleet and to cope with the swift torpedo vessels of the enemy. That this development has been due almost entirely to the introduction of such engineering features as steam turbines, small diameter watertube boilers fitted for burning oil, forced draft, forced lubrication, etc., is well known, and it is principally to such refinements in design that we must look for improvement in the future. Unless the destroyer becomes an armored vessel, it is doubtful if the size is ever increased more than is absolutely necessary to secure the necessary speed and steaming radius. But that marked improvement in design of such a vessel can be made without material increase in size has been shown only recently by the construction of the *Paramatta* for the Commonwealth of Australia. This vessel, designed by Professor Biles, is of practically the same dimensions as the modern British destroyers, but it has about 10 percent less displacement. In spite of this, she carries about a third more oil fuel than the Admiralty designed boats. The designed speed of the British destroyers is 27 knots, while that of the Australian vessel is 26 knots. On trial, however, she developed a maximum of 28.28 knots, and this result was obtained without forcing the boilers. At a cruising speed of about 14 knots, it has been shown that the fuel consumption of the vessel will admit of 20 percent greater steaming radius than the contract called for. The excellent results achieved with this design, simply indicate what can be looked for when the exigencies of the case demand a greater speed and greater steaming radius from this type of vessel.

Comparative Backing Trials of Scout Cruisers.

In connection with the summary of the comparative steam and coal consumption trials of the United States scout cruisers *Salem, Birmingham* and *Chester,* which is published elsewhere in this issue, it is of interest to note the result of comparative backing trials that have been carried out with these same vessels. These latter tests were made to gain information regarding the tactical features involved in the three modes of propulsion, since with reciprocating engines a backing power about equal to the ahead power is afforded without any increase in weight except that of the backing eccentrics, rods and links. With turbines, however, backing power requires additional turbines with a considerable increase in weight. Former practice has been to provide a backing power of about 50 percent of the ahead power, although as a matter of fact the backing power usually is rather less than 40 percent of the ahead power. The results obtained from the tests on the three scout cruisers showed that at all speeds the reciprocating engine provides better backing power than the Curtis turbines, and that the latter is superior to the Parsons turbine. The average time required for reversing was, for Parsons turbines, 8.2 seconds; for Curtis turbines, 39.2 seconds; for reciprocating engines, 5.1 seconds; and the average drop in boiler pressure was, for Parsons turbines, 82.4 pounds; for Curtis turbines, 75.8 pounds; and for reciprocating engines, none. In fact, in the case of the *Birmingham,* the average boiler pressure at the end of the backing interval was 1.5 pounds greater than at the beginning of the interval. The advantage of the reciprocating engine over the Curtis turbine and of the Curtis turbine over the Parsons turbine, increases slightly as the speed increases, although the proportion based upon the distance head reached by the vessel during the interval required to bring her dead in the water from a given speed ahead is practically constant.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		June 1.	July 1.
Florida	20,000	20¾	Navy Yard, New York	66.3	68.8
Utah	20,000	20¾	New York Shipbuilding Co.	76.0	80.0
Arkansas ...	26,000	20½	New York Shipbuilding Co.	27.6	34.6
Wyoming ..	26,000	20½	Wm. Cramp Sons	22.5	28.4

TORPEDO-BOAT DESTROYERS.

Paulding ...	742	29½	Bath Iron Works	89.4	92.4
Drayton	742	29½	Bath Iron Works	82.5	86.1
Roe	742	29½	Newp't News Shipbuilding Co.	88.7	92.3
Terry	742	29½	Newp't News Shipbuilding Co.	86.9	89.7
Perkins	742	29½	Fore River Shipbuilding Co.	79.6	86.8
Sterrett	742	29½	Fore River Shipbuilding Co.	77.1	83.8
McCall	742	29½	New York Shipbuilding Co.	76.5	85.4
Burrows	742	29½	New York Shipbuilding Co.	72.7	85.2
Warrington..	742	29½	Wm. Cramp & Sons	68.3	74.4
Mayrant	742	29½	Wm. Cramp & Sons	73.9	79.1
Monaghan ..	742	29½	Newp't News Shipbuilding Co.	19.9	26.7
Trippe	742	29½	Bath Iron Works	38.8	49.9
Walke	742	29½	Fore River Shipbuilding Co.	32.1	39.1
Ammen	742	29½	New York Shipbuilding Co.	40.4	48.5
Patterson ...	742	29½	Wm. Cramp & Sons	23.0	33.0

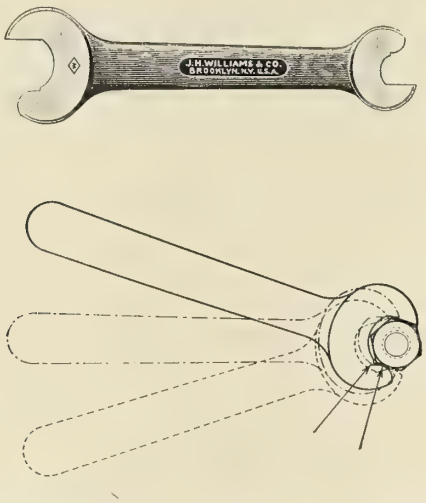
SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co.	94.7	97.4
Seal	...	..	Newp't New Shipbuilding Co.	50.1	51.2
Carp	...	..	Union Iron Works	53.5	58.6
Barracuda ..	...	..	Union Iron Works	53.5	58.6
Pickerel	...	..	The Moran Co.	50.4	53.1
Skate	...	..	The Moran Co.	50.4	53.1
Skipjack	...	..	Fore River Shipbuilding Co.	40.1	45.3
Sturgeon ...	...	..	Fore River Shipbuilding Co.	38.9	43.7
Tuna	...	..	Newp't News Shipbuilding Co.	26.2	28.3
Thrasher ...	...	..	Wm. Cramp & Sons	5.7	6.4

ENGINEERING SPECIALTIES.

Williams Rachet Wrench.

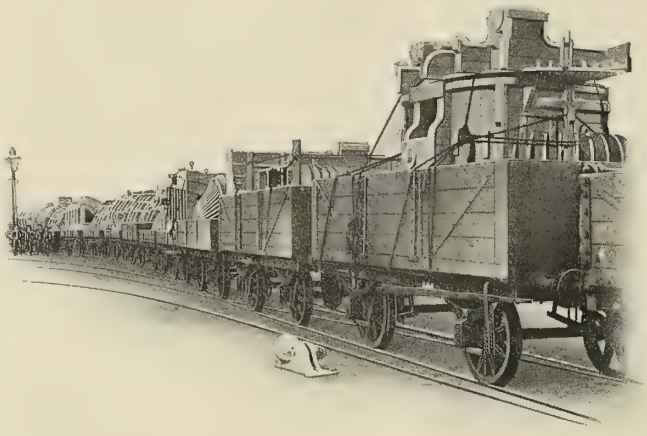
J. H. Williams & Company, Brooklyn, N. Y., have just placed on the market a new drop-forged wrench, which is practically a ratchet wrench without any ratchet mechanism. It is claimed that it will do anything that any other drop-forged wrench can do, and do it with imperceptible wear on the nut or tool. The principle involved in moving any nut, set screw, etc., with a wrench is two points of contact. The designer of this wrench



appreciated this fact, and cut out the useless end of the ordinary wrench, producing a tool with a reciprocating action which promises to revolutionize the use of drop-forged wrenches. It is not necessary to lift the tool from each side of the nut, as is done with an ordinary wrench, but the action is progressive and rapid, making the tool a timesaver. No pawl or other mechanism is necessary, since turning over the tool enables either right or left-hand adjustment of the nut.

Interesting Shipment of Turbine Patterns.

We show herewith a photograph of a large consignment of turbine cylinder patterns, which were made by David Brown & Sons, Huddersfield, for the Cunard express steamer *Lusitania*. The *Lusitania* was built on the Clyde, and as the patterns

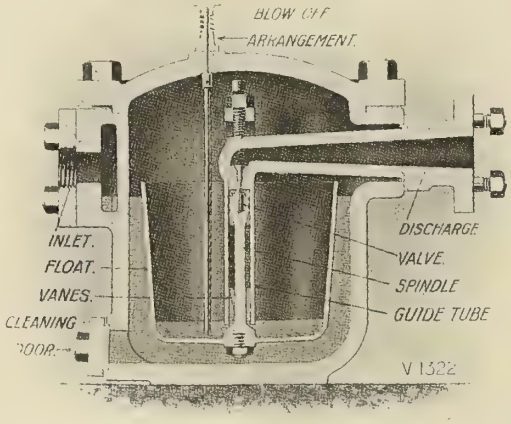


were too large in diameter for railway transit they had to be made in quarters dowelled together. About 11¼ standards of 2 inches diameter were used, and some 7,500 hours spent on these patterns.

The Sentinel Steam Trap.

The Sentinel steam trap, made by Alley & MacLellan, Ltd., Sentinel Works, Glasgow, automatically regrinds its valve after each discharge. This feature, it is claimed, preserves its tightness with gritty steam. The trap has only one moving part, which, as shown in the illustration, is the float to which is attached the spindle, guided in the vertical tube by spirally-formed vanes and having on its point a valve. The float is free to rise or fall or to rotate.

In action the chest fills with water, which overflows into the float, filling it up and sinking it. In sinking, the float opens the valve through which the water is discharged by the steam pressure, and thus lightened the float rises, again closing the outlet.

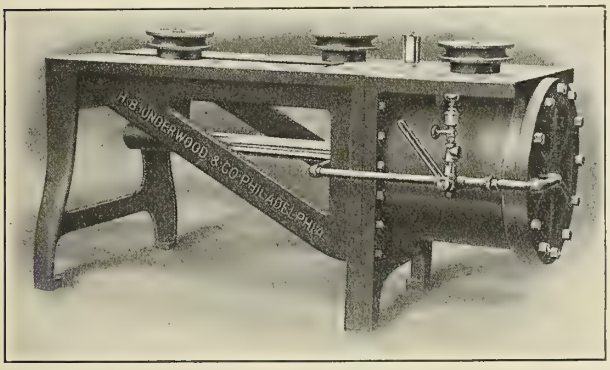


It is pointed out that the float must sink at once, and that when closing the valve acts as a check valve. It is claimed, therefore, that the trap cannot balance and the action cannot generate into a dribble. It is claimed that during the discharge the float is revolved practically without friction by the impingement on the vanes of the water flowing up the guide tube. This radial motion attains its maximum speed as the valve is about to shut, and by the fly-wheel action of the rim of the float the valve is reground each time the trap acts. Any

roughness on the valve faces caused by grit is thus burnished over and remedied almost as soon as it occurs, thus keeping the trap tight indefinitely.

New Underwood Pipe-Bending Machine.

The pipe bender which is shown in the accompanying illustration has been placed on the market by H. B. Underwood & Company, 1025 Hamilton street, Philadelphia, Pa., and besides being efficient for the bending of pipes may also be employed as a bulldozer and power bender. The length of stroke is 15 inches, and the control very flexible. The rectangular work table is of ample dimensions, and numerous holes are provided for conveniently locating dies and pins. No obstruction that will interfere with the work in any way is presented by the top of the table, as it is perfectly flat. The large number of dies which are ordinarily required for bending a great variety of pieces is avoided, as simply changing the position of the resistance studs permits varying the shapes at will. The ram, located beneath the table, slides in a strongly constructed guide, and is provided with a stud projecting above the table on which a roll of suitable size may be placed. Steam or compressed air may be used to operate the machine, and for the former a



metallic packing is used on the piston rod and for the latter a leather packing. The use of compressed air has many advantages over the use of steam, and the maker recommends it as a motive power when available. The diameter of the cylinder is 20 inches, and the supply of working fluid admitted to the piston is the only limit placed on the power of the machine.

A special feature that is very advantageous and worthy of particular attention is that the piston has air on both sides of it at all times. Because of a special construction of the operating valve only the amount of working fluid required for actual bending is wasted, as it is transferred from one side of the piston to the other, and the piston is forced forward because that side offers a larger area than the other, which is smaller because of the space occupied by the piston rod. Thus the piston can be moved only a fraction of an inch when necessary, or it may be held perfectly stationary for measuring the work. Such a precise control is desirable in all sorts of bending work and is particularly useful in straightening bent pieces.

Reno Inclined Truck Elevator.

The illustration shows one of several installations of the Reno inclined truck elevators which the Reno Inclined Elevator Company, of New York, have made on steamship docks. This method of conveying trucks is entirely new, and the simplicity of the design and economy in first cost will appeal to the superintendents of docks, warehouses and other situations where loaded trucks are to be conveyed up and down an incline. The machine illustrated is in use at the Pequonnock Dock, Bridgeport, Conn., owned by the New York, New Haven & Hartford Railroad Company. It consists of an endless steel chain provided with special projections which engage the axle of the truck. This chain is supported by and slides in a lubricated steel channel, and is kept in continuous motion by a sprocket wheel at either end driven by an electric motor and reduction gearing, the motor being located in a box on the floor of the freight house shown in the lower right-hand corner of the picture, and driving a shaft under the floor to which the sprocket wheel is keyed. It is claimed that the machine is under perfect control of the attendant, and can be started, stopped and reversed by turning a switch. It will be noted that the truck wheels carry the load, the chain simply engaging the axle and thus pulling the truck up the incline. It will also be

noticed that the men walk up the incline with their feet on opposite sides of the narrow partition, 4 inches wide. An important feature claimed for the machine is its perfect safety to the workmen, as there is no moving platform, which require great care from those who are using them in order to prevent the feet from being caught. The speed of the moving chain is 100 feet per minute, at which rate it will deliver 960 trucks per hour. A 5-horsepower motor runs the conveyor. The apparatus can be designed to be lowered out of sight and the slot covered with a steel channel. This is also a very important feature of this machine, as in this position the surface of the platform is unobstructed and can be used by the workmen for loading and unloading freight when the incline is almost level and the truck elevator is not necessary. The chain and sprocket wheels are attached to a steel truss which is pivoted at either end, and by means of a powerful screw and a suitable handle one man can lower or raise the machine into position in a few seconds.

PERSONAL.

Chief Constructor W. L. Capps, whose resignation as the chief of the Bureau of Construction and Repair will take effect in October, expects to leave Washington early in August on an inspection trip which he had planned some weeks ago. Naval Constructor Richard M. Watt, who has been on duty as construction officer at the Norfolk navy yard, will go on duty in the Bureau of Construction and Repair in anticipation of succeeding to the office of chief constructor in October.

TECHNICAL PUBLICATIONS.

The Naval Pocketbook. 1910. Edited by Rollo Laird Clowes. Size, 3½ by 5 inches. Pages, 1,032. Numerous illustrations. London, 1910. W. Thacker & Company. Price, 7/6 net.

Of all the naval annuals which are published this is probably the most concise and convenient for ready reference, since the information is given in a semi-tabulated form and the volume is published in pocket size. There are no new features in this edition, but the book has been carefully revised and corrected to March 14, with addenda to May 6, 1910. The contents include a classification of ships, a comparative summary of the fighting fleets, a classified and analytical list of the navies of all nations, complete information regarding the guns and small arms of the various nations, a table of the latest rifles of States possessing navies, notes on torpedoes, naval personnel and comparative rank and retiring ages in European navies, notes on navy estimates, details of the world's drydocks, trial trip tables, and the usual plans of battleships and cruisers of the various navies, showing the location and extent of armor and gun emplacement.

Jordan's Tabulated Weights of Iron and Steel. Sixth edition. By Charles H. Jordan, M. I. N. A. Size, 5 by 3⅛ inches. Pages, 640. Numerous illustrations. London, 1909: E. & F. N. Spon, Ltd., and New York, 1909: Spon & Chamberlain. Price, 7/6 net.

The new edition of this well-known work is necessitated in part by the alterations which have recently been made in the rules of *Lloyd's Register of Shipping* by the adoption of a decimal system in denoting the thicknesses of various sections of steel to be used in the building of vessels for classification in this society. This alteration has necessitated the production of a series of tables of weights and sectional areas in accordance therewith. These tables have, therefore, been added to the present edition, and they are based upon the British standard ship sections as drawn up by the Engineering Standards Committee and approved by Lloyds.

The volume includes tables of weights of iron and steel plating and sections of various standard gage thicknesses and diagrams and sectional areas of various iron and steel shapes; weights and sectional areas of steel in thicknesses of twentieths and fortieths of an inch; weights and sectional areas of steel in thicknesses of thirty-seconds of an inch; equipment weights for all classes of vessels; tables of decimal equivalents of the foregoing; tables of equivalent weights and measures in metric and British units, and finally the additional tables of weights and sectional areas of steel sections contained in Lloyd's Rules, based upon the British standard sections in thicknesses of fiftieths of an inch and also decimal equivalents, etc.

Board of Trade Arithmetic for First and Second Class Engineers. By Peter Youngson. Size, 4½ by 7⅛ inches. Pages, 332. Numerous illustrations. Glasgow, 1910: James Munro & Company, Ltd. Price, 5/ net.

Candidates for Board of Trade examinations for first and second class engineers will find this book of great value, since it gives several sets of examination papers, with complete solutions to the problems worked out in detail, showing each step and all of the numerical computations. In the introduction the author calls attention to two important points which deserve emphasis. One is the precision which should be aimed at in the solution of these problems. He shows how ridiculous it is to attempt to work out problems to four or more decimal places when the data given has been got with instruments in which there is opportunity for error as great as 5 percent. As practical men, engineers should use practical methods and have a comprehensive idea of the value and precision of the results obtained by these methods. For instance, it is a waste of time to calculate the indicated horsepower of an engine from diagrams to, say, two decimal places when the indicator has in all probability an error of 5 percent either way, so that the actual indicated horsepower of the engine may vary by 50 or 100 horsepower. The second point to which he calls attention is the necessity for indicating in the solution of problems the various steps by which the final result is reached, so that the method as well as the actual computation is clearly indicated.

The first few pages of the book explain the various arithmetical computations which it is necessary to know to solve the problems. A set of second class examination papers is then given, which is immediately followed by the complete solution of each problem separately. This is followed by a second set of second class examination papers to which merely the answers of the problems are given. Similarly, two sets of first class examination papers are given, for one of which complete solutions of the problems are worked out while for the other simply the answers are given.

Ship Construction and Calculations. By George Nichol. Size, 6½ by 9¼ inches. Pages, 330. Figures, 239. New York, 1910: D. Van Nostrand Company. Price, $4.50 net.

This book was reviewed in our February, 1910, issue, as received from the Glasgow publishers, James Brown & Son. The American edition does not differ from the English edition.

Lloyd's Register of American Yachts, 1910. Size, 9 by 7 inches. Pages, 456. Colored plates, 48. New York, 1910: *Lloyd's Register of American Yachts.* Price, single copies, blue coth, gilt edges, $8.50; canvas, plain edges, $7; subscription prices, $7.50 and $6.

This volume, which makes its appearance for the eighth successive year, is unchanged in its appearance from last year, but an inspection of its various departments discloses good grounds for the claim of the publishers that it is necessary to make the book entirely new every year. The changes in the 3,500 entries of the yacht list proper show a complete reorganization of the American pleasure fleet on a new basis, the gasoline engine displacing rope and canvas more rapidly than in any previous year. With but three new additions to the sailing fleet there are to be noted many omissions of famous yachts, schooners and cutters sold for commercial service or broken up. Of the older and larger sailing vessels still left the great majority are now auxiliaries. The new auxiliary bark *Aloha*, 218 feet over all, with a gross tonnage of 659, stands alone among the new yachts of the year. Next in importance to her in the way of additions to the list are the cruising power yachts of from 80 to 100 feet, of a type which combines good cruising speed with sea-going qualities. In this connection another interesting change is to be noted, namely, the removal of steam-propelling machinery from some of the older yachts and the substitution of gas engines. An entirely new type that is found in the *Register* this year for the first time is the ocean cruiser of about 60 feet length, the product of the long-distance ocean races of recent years to Bermuda and Havana.

The most numerous additions to the yacht list are found in the new type of raised-deck power cruisers of from 30 to 60 feet over all. Of purely racing types, the majority are found in such small sailing yachts as the *Sonder* class and *Seawanhaka* cup class, and in the 40-foot class of full-powered launches.

One notable feature is the increase in the number of clubs, the total being 458, as compared with 159 in the 1905 *Register*. This increase is made up in part of the conventional yacht clubs, but largely of clubs whose membership is specially devoted to power yachting. The commercial value of this side of yachting, as represented in engine building and allied industries, cannot be estimated. The incidental features of the book include the usual list of yacht owners, the flags and colors of all the clubs, and of 2,047 individual yachtsmen, a list of thirty-one yachting associations, a list of the late names of yachts, signal letters carried by yachts, etc.

Sea Power and Other Studies. By Admiral Sir Cyprian Bridge, G. C. B. Size, 5 by 7 inches. Pages, 311. London, 1910: Smith, Elder & Company. Price, 5/– net.

Admiral Bridge has spent a lifetime in the service, and since he entered the navy in 1853 he has been a careful observer. Therefore he is well qualified to turn his experience and observation to good service in his writings. The present volume is a collection of a dozen essays written during the past few years for leading magazines. They are of permanent interest, and will serve to correct some accepted and erroneous conclusions. The historical studies dealing with "Facts and Fancies About the Press Gang," "Projected Invasions of the British Isles," "Queen Elizabeth and Her Seamen," and the two studies on Nelson and Trafalgar, particularly the one which deals with "Naval Strategy and Tactics at the Time of Trafalgar," are of special interest. The latter is the substance of a paper read before the Institute of Naval Architects. The two fine essays on "Sea Power" and the "Command of the Sea," which are to be found in the Encyclopædia Britannica, are included. Both of these are too well known to be commented upon. The whole volume is of the highest value, and constitutes a valuable addition to naval literature.

QUERIES AND ANSWERS.

Questions concerning marine engineering will be answered by the Editor in this column. Each communication must bear the name and address of the writer.

Q.—Please explain the construction and operation of the type of boiler feed pump used on American river steamboats known as the "Doctor." Also state the reasons for its use in place of ordinary feed pumps and injectors. A. B. Sears.

A.—The "Doctor" type of feed pump to which you refer was designed to give a steady supply of feed water to boilers under all conditions of steam pressure and with sandy or muddy water. It consists of a vertical beam engine with crank and fly-wheel operating four pumps. Two of these are simple lift pumps, drawing water from the river and discharging it into an open feed-water heater at the top of the apparatus. The other two pumps are feed pumps taking their supply from the heater and forcing the water into the main boilers. Each force and suction pump is usually designed to have ample capacity to feed the entire battery of boilers, so that in case of accident any one of the pumps may be disconnected for repairs without interrupting the service.

The base plate upon which the various details are erected is deep, and contains numerous ports and passageways, which form the water connections between the various parts of the pump. The suction pipe from the river or hot well, as the case may be, is connected with a vacuum chamber, and connects through a passage in the base casting with the suction side of the two lift pumps. The discharge from these pumps is also connected by similar passages to pipes leading to the feed-water heater, or sometimes the columns supporting the heater serve as discharge pipes, and the water passes through them on its way to the heater. The heater usually consists of a wrought iron or steel shell riveted to cast iron heads, in which is a coil of copper pipe through which the exhaust steam from the main engine passes.

The water from the heater flows to the base plate and to the suction valves of the feed pumps, the head of water being sufficient to flood the valves and prevent the feed pump from missing stroke on account of vaporization of the heated water.

The lift pumps are fitted with long pistons, having cup leather packing in some cases and in others square gum packing fitted into suitable grooves is used, while the pumps are arranged with outside packed plungers having deep stuffing-boxes and heavy glands fitted to the pump barrels. The pump valves are flat discs of brass, properly guided and fitted to flat brass seats. The valves are made extra heavy so as to avoid the necessity of springs and at the same time allow ample metal for facing off. All the working parts are simple in construction and very accessible, so that the pump is able to work in all kinds of water, handling hot feed against high steam pressures, both effectively and economically.

The reason the "Doctor" is used in preference to other means of feeding is principally because engines of American Western river steamers are run non-condensing, and the feed is taken directly from the river, and in most cases contains a high percentage of sand and mud, which would quickly wear out injector tubes and cause an immense amount of trouble.

AMERICAN NAVAL APPROPRIATIONS.

The total sum appropriated by Congress for the American naval establishment for the fiscal year 1911 amounts to $131,350,854 (£27,000,000), which is $5,500,000 (£1,130,000) less than provided last year.

Among the various items included in the bill those authorizing the construction of new ships are of especial interest to the shipbuilders of the country. The bill provides for the construction of two first class battleships the cost of each not to exceed $6,000,000 (£1,233,000) to have a speed of 21 knots with a displacement or 27,000 tons (the cost is exclusive of armor and armament); the construction of six torpedo boat destroyers at a cost of $750,000 (£154,000) each; two fleet colliers of 14 knots speed to carry 12,500 tons when fully loaded, inclusive of bunker coal, the total cost of each not to exceed $1,000,000 (£205,500); the construction of four submarines at a cost of $500,000 (£102,800) each.

Besides the foregoing $445,000 (£91,500) is made available for the construction of a certain torpedo vessel of an experimental nature.

The suspension of the Bureau of Equipment was passed on by the present bill. The duties of said bureau shall, according to the bill, be distributed among the other bureaus of the Navy Department in such manner as the Secretary of the Navy considers expedient, and shall be in force until the end of the fiscal year 1911. The order containing the distribution of the duties assigns, besides the various assignments made to the Bureau of Navigation, Yards and Docks, Supplies and Accounts, to the Bureau of Construction and Repair the supply and manufacture of anchors, cables, rope, rigging, sails, awnings and flags, also the supply and fitting of galley appurtenances, the installation of electric wiring, voice tubes and devices of mechanical communication. To the Bureau of Steam Engineering is given electrical machinery and appliances, except those now in charge of other bureaus, the manufacture and installation of wireless telegraph outfits, both for ships and shore stations. Also the operation of coaling plants and the approval of the plans for such plants.

Of the appropriations provided for in the bill the following figures, given in round numbers, designate the purpose:

Pay of the navy	$34,615,500	(£7,125,000)
Bureau of Navigation	3,358,400	(691,000)
Bureau of Ordnance	11,363,500	(2,335,000)
Bureau of Equipment	8,038,300	(1,652,000)
Bureau of Yards and Docks	1,320,000	(271,500)
Public Works	7,090,000	(1,459,000)
Bureau of Medicine and Surgery	401,000	(82,500)
Bureau of Supplies and Accounts	8,065,000	(1,658,000)
Bureau of Construction and Repair	9,112,000	(1,870,000)
Bureau of Steam Engineering	6,276,000	(1,290,000)
Increase of the navy	33,775,000	(6,950,000)

The remainder is divided between the Naval Academy and the Marine Corps.

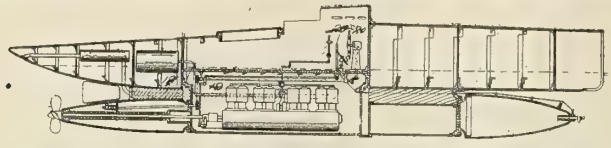
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

954,713. MARINE VESSEL. CLARENCE LIVINGSTON BURGER, OF NEW YORK, N. Y.

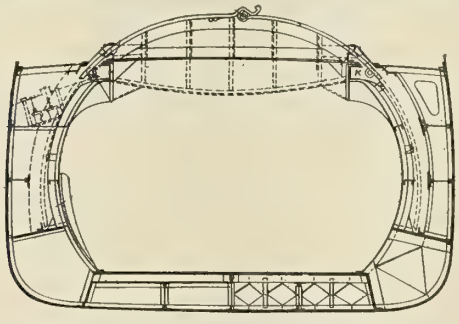
Claim 1.—A dirigible marine vessel consisting of a submerged hull suspended from and communicating with a surface hull, and having its



motor control accessible to the attendant in the surface hull, the submerged hull comprising an outwardly removable section to give access to the motor closely confined therein. Ten claims.

956,152. SHIP AND SHIP'S HATCH. JOSEPH R. OLDHAM, OF CLEVELAND, OHIO.

Claim 1.—In a bulk cargo vessel having a steel deck, the combination of transverse hatch coamings having channels or gutters on their peripheries, which rise on a curve from the decks at the sides of the hatchways; longitudinal slots in the deck near said sides, inwardly inclined longitudinal coamings at the sides of said slots, hatch chambers at the sides of the holds communicating with said slots, curved metal



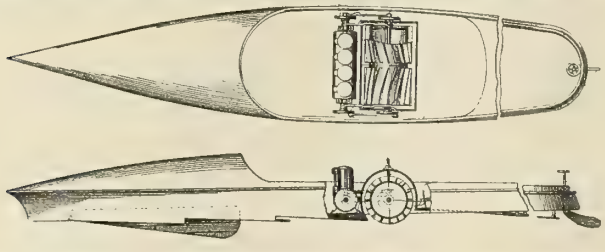
hatches adapted to slide or ride on rollers along said transverse coamings and through said slots into said hatch chambers, and portable hatch bars adapted to be fitted between said inclined coamings and the outside of the curved hatches to prevent water leaking into the hatch chambers, in which said hatches are housed when moved off the transverse coamings which support them. Nine claims.

956,442. WARSHIP. NABOR SOLIANI, OF SESTRI PONENTE, NEAR GENOA, ITALY.

Claim.—A battleship or cruiser provided with an armor belt and a protective deck having sloping sides which meet the ship's sides at a considerable distance below the lower edge of the armor belt. One claim.

956,487. HYDROPLANE BOAT. WILLIAM HENRY FAUBER, OF CHICAGO, ILL.

Claim 1.—A hydroplane boat having a pointed bow and a substantially flat bottom, and provided with a paddle wheel which is located at the widest part of the hull and projects downwardly through an opening in the flat bottom thereof, and with downwardly and rearwardly in-



clined hydroplane members extending transversely of said bottom forward and at the rear of the paddle wheel; said paddle wheel being substantially equal in length to the width of the hydroplane members at the front and rear of the same. Nineteen claims.

955,130. SHIP ELEVATOR, CRADLE, AND DOCK. EDWARD L. BURWELL, OF WINCHESTER, MASS.

Claim 2.—A counterbalanced elevator and cradle, the latter movable longitudinally on the former, means on the cradle laterally movable toward and from a vessel thereon, to maintain the vessel upright on the cradle, and means to govern the elevation and descent of the elevator and its load, said means including a system of weight units adapted to be brought singly into co-operation with the elevator, to act cumulatively thereupon. Twenty-five claims.

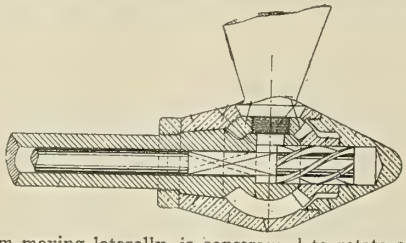
955,721. SCREW PROPELLER. RICHARD TJADER, OF NEW YORK, N. Y.

Claim 1.—A screw propeller having a continuous blade that extends a complete convolution about its shaft and that increases in pitch from front to rear in geometric progression. Thirty claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C.; and 21 Southampton building, W. C., London.

9,196. REVERSIBLE AND FEATHERING PROPELLERS. F. L. NEWHOUSE, H. M. S. *CAMPERDOWN*.

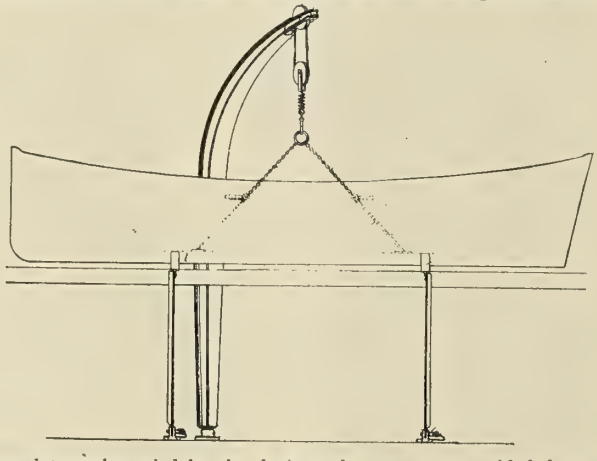
By this invention the blades are set at any desired angle by means of a push rod operated from within the ship or boat, through the hollow tail shaft. The push rod terminates in a coarse pitch screw, which carries a bevel wheel, and when the push rod is moved this bevel wheel,



prevented from moving laterally, is constrained to rotate and so in turn rotates the bevel wheels affixed to the base of the movable blades, thus giving the desired alteration in the angle of the blades and feathering, or reversing the pitch as may be desired.

16,610. BOAT'S DAVITS AND LOWERING GEAR THEREFOR. J. GRAHAM, GLASGOW.

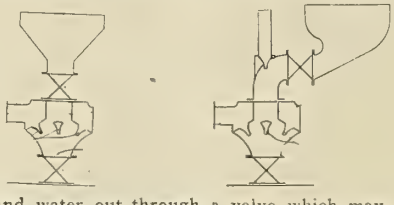
The invention consists in providing an improved single davit, which turns upon a vertical axis, and from which the boat is slung centrally by a single rope, the winding gear for lowering and raising the boat being



secured to and carried by the davit, and means are provided for automatically locking the davit in the outmost lowering position and also in the inboard position.

11,258. APPARATUS FOR EJECTING ASHES. F. J. TREWENT AND W. E. PROCTOR, LONDON.

Claim.—The ashes are charged into a hopper through a suitable valve. Water is forced into the annulus to issue from jets and force the mix-



ture of ashes and water out through a valve which may be below the sea level. Various modifications and variations are described.

12,228. PROPULSION OF VEHICLES OR SHIPS. GEBRUDER SULZER, WINTERTHUR, SWITZERLAND.

Claim.—Relates to a two-stroke internal combustion engine started by compressed air supplied by an auxiliary motor, the fuel being injected and fired at the moment of compression and during part of the working stroke. Reversing is effected by cam and lever, which control the air admission. After starting, air is required for combustion only. The auxiliary engine is regulated by a governor in conjunction with a piston.

16,241. SPEED INDICATORS. L. A. COTTON, HORNSBY, NEAR SYDNEY, N. S. W., AUSTRALIA.

Claim.—The speed is indicated by means of a "Pitot" tube and balance tube outside the ship and connected to a manometer tube containing mercury which is raised in the right leg beside a speed scale. Surging of the mercury is prevented by small bore plugs in the connecting pipes and "drag" in the balance tube is avoided by setting its mouth at an angle. The speed is recorded, on a clockwork-moved strip, by a pencil on a lever oscillated by a solenoid. This is actuated by current passing through a fine wire traversing the mercury column. When the latter rises the resistance decreases and the pencil also rises.

30,342. FOG-SIGNALLING APPARATUS. G. FINGERLING, HANOVER, GERMANY.

The object of this invention is to substitute olfactory signals for audible signals. Fine spray of odoriferous matter is distributed around the ship by jets at points. The liquid, an ammoniacal solution, for example, is forced by steam or otherwise through a pipe, induces sea water up the pipes and is ejected as a mixture through a nozzle.